

DATA SHEET

LCD MODULE

**DEM 240320K TMH-PW-N
(A-TOUCH)**

2,8“ TFT

Product Specification

Ver.: 4

Revision History

Revision	Date	Originator	Detail	Remarks
0	01.04.2014		Initial Release	
1	14.04.2014		Modify General Description Modify Interface Add wiring diagram Modify AC Characteristics Modify Outline drawing	P4 P4 P13 P16-P19 P33
2	27.05.2014		Update IC to ILI9341V	P4 P5 P11-13 P14-20 P21-28 P38
3	20.06.2014		Add Weight Add Current Consumption Modify Chromacity Transmissive Modify Inspection Specification	P4 P5 P7 P33
4	27.05.2020		Modify Luminance Modify Reliability Specification Modify Outline Drawing	P7 P35 P39

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1. General Description

The specification is a transmissive type color active matrix liquid crystal display (LCD) which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT-LCD panel, driver ICs, a touch panel and a backlight unit. This TFT Module is having an universal interface pin layout to access all relevant interfaces of the TFT Driver IC. It allows to be flexible in case of TFT driver IC changes.

2. Module Parameter

Features	Details	Unit
Display Size (Diagonal)	2.8"	-
LCD Type	TN TFT	-
Display Mode	Transmissive / Normally White	-
Resolution	240 RGB x 320	Pixels
View Direction	6 O'clock	Best Image
Gray Scale Inversion Direction	12 clock	-
Module Outline	50.00 x 69.20 x 3.70 (Note1)	mm
Active Area	43.20 x 57.60	mm
Pixel Size	0.180 x 0.180	mm
Pixel Arrangement	R.G.B. Vertical Stripe	-
Polarizer Surface Treatment	Anti-Glare	-
Display Colors	262k	-
Interface	8/9/16/18 MPU Interface or 3-wire 9-bit Interface + RGB Interface or 4-wire 8-bit Interface + RGB Interface	-
With or without touch panel	With 4-Wire-Resistive Touch	-
Driver IC	ILI9341V (Ilitek)	-
Operating Temperature	-20 ~ 70	°C
Storage Temperature	-30 ~ 80	°C
Weight	22	g

Note 1: Exclusive hooks, posts, FFC/FPC tail etc.

3. Absolute Maximum Ratings

$V_{SS}=0V, T_a=25^{\circ}C$

Item	Symbol	Min.	Max.	Unit
Supply Voltage	Logic	-0.3	4.6	V
	Analog	-0.3	4.6	V
Storage Temperature	T _{STG}	-30	+80	°C
Operating Temperature	T _{OP}	-20	+70	°C

Note 1: If T_a below $50^{\circ}C$, the maximal humidity is 90%RH, if T_a over $50^{\circ}C$, absolute humidity should be less than 60%RH.

Note 2: The response time will be extremely slow when the operating temperature is around $-10^{\circ}C$, and the back ground will become darker at high temperature operating.

4. DC Characteristics

Item		Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	Logic	IOVCC	1.65	1.8/2.8	3.3	V
	Analog	VCC	2.4	2.8	3.3	V
Logic Low Input Voltage		V _{IL}	GND	-	0.3*IOVCC	V
Logic High Input Voltage		V _{IH}	0.7*IOVCC	-	IOVCC	V
Logic Low Output Voltage		V _{OL}	GND	-	0.2*IOVCC	V
Logic High Output Voltage		V _{OH}	0.8*IOVCC	-	IOVCC	V
Current Consumption All Black	Logic	I _{CC+ IIN}	-	10	30	mA
	Analog					

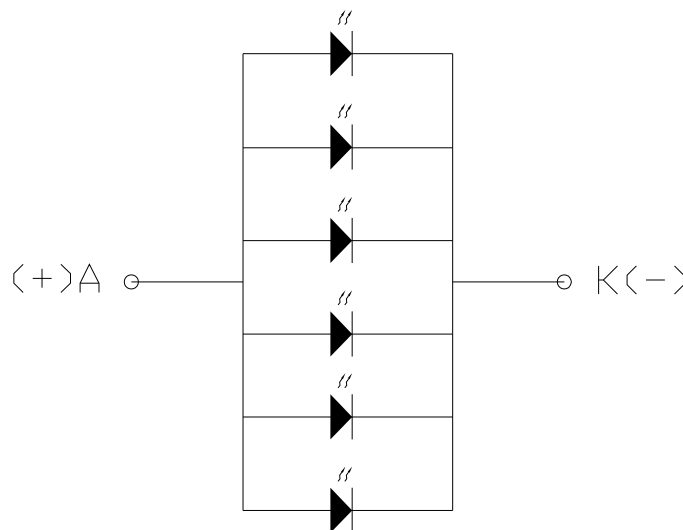
5. Backlight Characteristic

5.1. Backlight Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	V _F	T _a =25 °C, I _F =20mA/LED	2.9	3.2	3.4	V
Forward Current	I _F	T _a =25 °C, V _F =3.2V/LED	-	120	-	mA
Power Dissipation	P _D		-	384	-	mW
LED Life Time(25 °C)	-	-	-	(30,000)	-	Hr
Uniformity	Avg		80	85	-	%
Drive Method	Constant Current					
LED Configuration	6 White LEDs in parallel					

Note: LED life time defined as follows: The final brightness is at 50% of original brightness. The environmental conducted under ambient air flow, at T_a=25±2 °C, 60%RH±5%, I_F=20mA/LED.

5.2. Backlighting Circuit



6. Touch Screen Panel Specifications

6.1 Electrical Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Linearity	-1.5	-	1.5	%	Analog X and Y directions
Terminal Resistance	100	-	550	Ω	X(Film side)
	300	-	850	Ω	Y(Glass side)
Insulation Resistance	20	-	-	M Ω	DC \leq 10V
Voltage	-	5	10	V	DC
Chattering	-	-	10	ms	

Caution (1): Do not operate it with a thing except a polyacetal pen (tip R0.8mm or less) or a finger, especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

6.2 Mechanical & Reliability Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Activation Force	30	-	120	g	(1)
Durability-Surface Scratching	Write 20,000	-	-	characters	(2)
Durability-Surface Pitting	1,000,000	-	-	touches	(3)
Surface Hardness	3	-	-	H	

Note (1) Stylus pen Input: R0.8mm polyacetal pen or Finger

Note (2) Measurement for Surface area

- Force: 150-250gf
- Speed: 60mm/sec
- Stylus: R0.8 polyacetal pen or Finger

Note (3) Pit 1,000,000 times on the Film with a R3.75 silicon rubber.

- Force: Force: 2.45N
- Speed: 3times/sec

7. Optical Characteristics

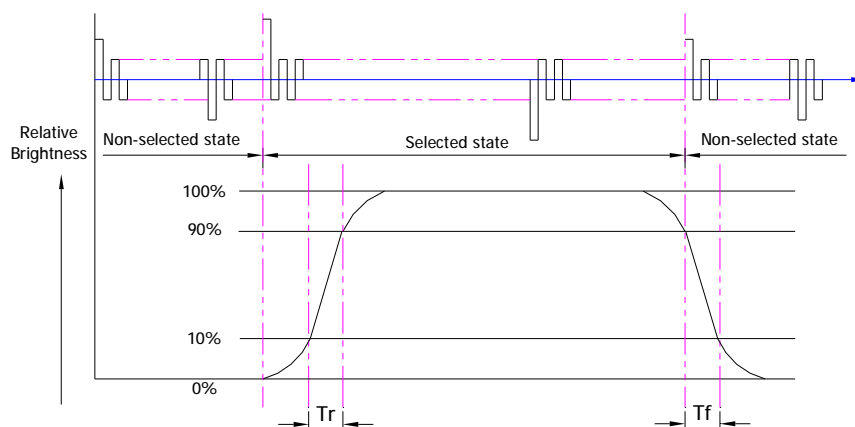
7.1. Optical Characteristics

Ta=25°C, V_{DD}=2.8V, TN LC+ Polarizer

	Item	Symbol	Condition	Specification			Unit	
				Min.	Typ.	Max.		
Backlight On (Transmissive Mode)	Luminance on TFT(I _f =20mA/LED)	Lv	Normally viewing angle θ _x = φ _y = 0°	450	560	-	cd/m ²	
	Contrast Ratio(See 7.3)	CR		400	500	-		
	Response Time (See 7.2)	T _{R+TF}		-	16	32	ms	
	Chromaticity Transmissive (See 7.5)	Red	X _R	Center CR≥10	0.570	0.620	0.670	
			Y _R		0.296	0.346	0.396	
		Green	X _G		0.245	0.295	0.345	
			Y _G		0.578	0.628	0.678	
		Blue	X _B		0.097	0.147	0.197	
			Y _B		0.048	0.098	0.148	
		White	X _W		0.246	0.296	0.346	
			Y _W		0.287	0.337	0.387	
	Viewing Angle (See 7.4)	Horizontal	θ _{x+}	50	60	-	Deg.	
			θ _{x-}	50	60	-		
		Vertical	φ _{y+}	50	60	-		
φ _{y-}			40	50	-			
NTSC Ratio(Gamut)				-	60	-	%	

7.2. Definition of Response Time

7.2.1. Normally Black Type (Negative)

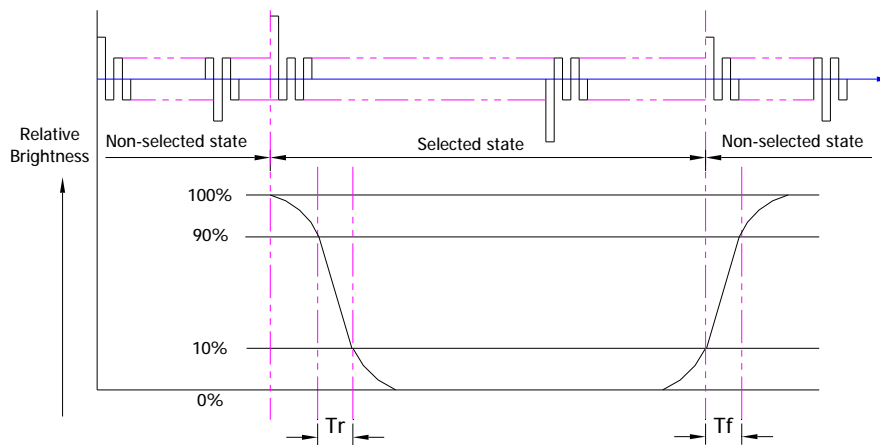


Tr is the time it takes to change from non-selected stage with relative luminance 10% to selected state with relative luminance 90%;

Tf is the time it takes to change from selected state with relative luminance 90% to non-selected state with relative luminance 10%.

Note: Measuring machine: LCD-5100

7.2.2. Normally White Type (Positive)



Tr is the time it takes to change from non-selected stage with relative luminance 90% to selected state with relative luminance 10%;

Tf is the time it takes to change from selected state with relative luminance 10% to non-selected state with relative luminance 90%;

Note: Measuring machine: LCD-5100 or EQUI

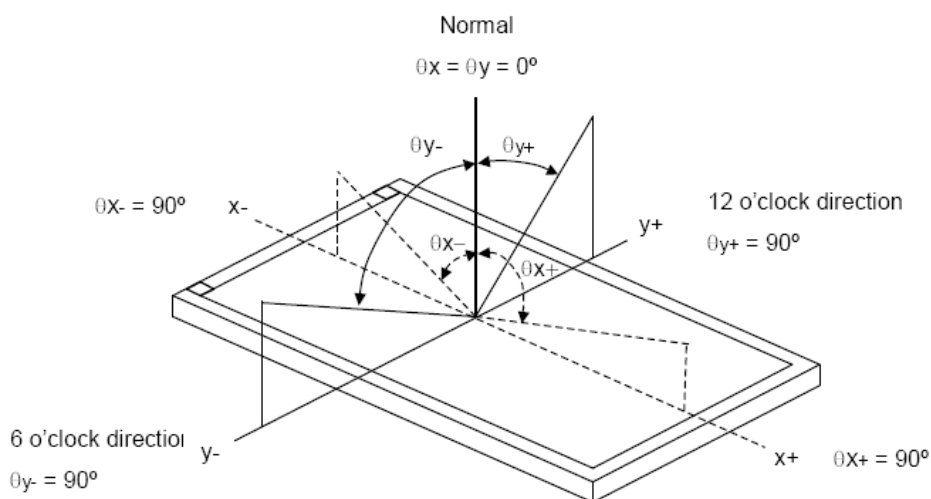
7.3. Definition of Contrast Ratio

Contrast is measured perpendicular to display surface in reflective and transmissive mode. The measurement condition is:

Measuring Equipment	Eldim or Equivalent
Measuring Point Diameter	3mm//1mm
Measuring Point Location	Active Area centre point
Test pattern	A: All Pixels white B: All Pixel black
Contrast setting	Maximum

Definitions: CR (Contrast) = Luminance of White Pixel / Luminance of Black Pixel

7.4. Definition of Viewing Angles



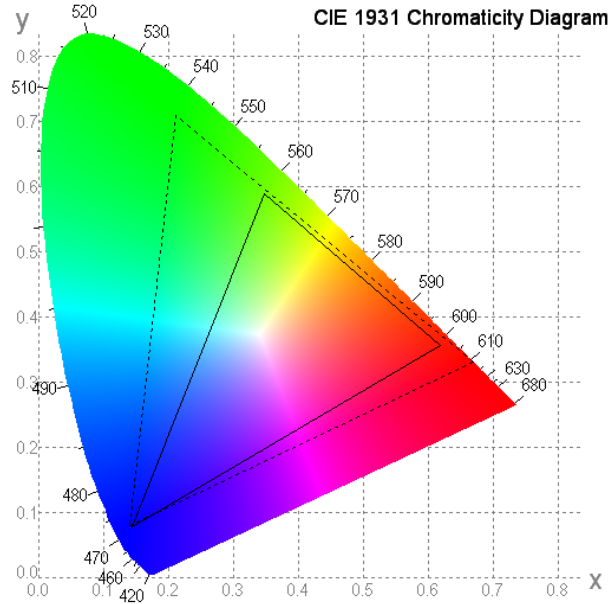
Measuring machine: LCD-5100 or EQUI

7.5. Definition of Color Appearance

R,G,B and W are defined by (x, y) on the IE chromaticity diagram

NTSC=area of RGB triangle/area of NTSC triangleX100%

Measuring picture: Red, Green, Blue and White (Measuring machine: BM-7)

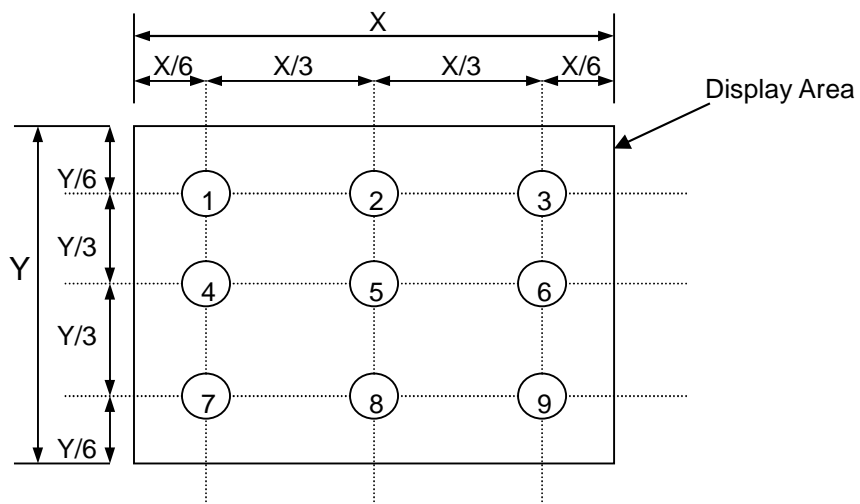


7.6. Definition of Surface Luminance, Uniformity and Transmittance

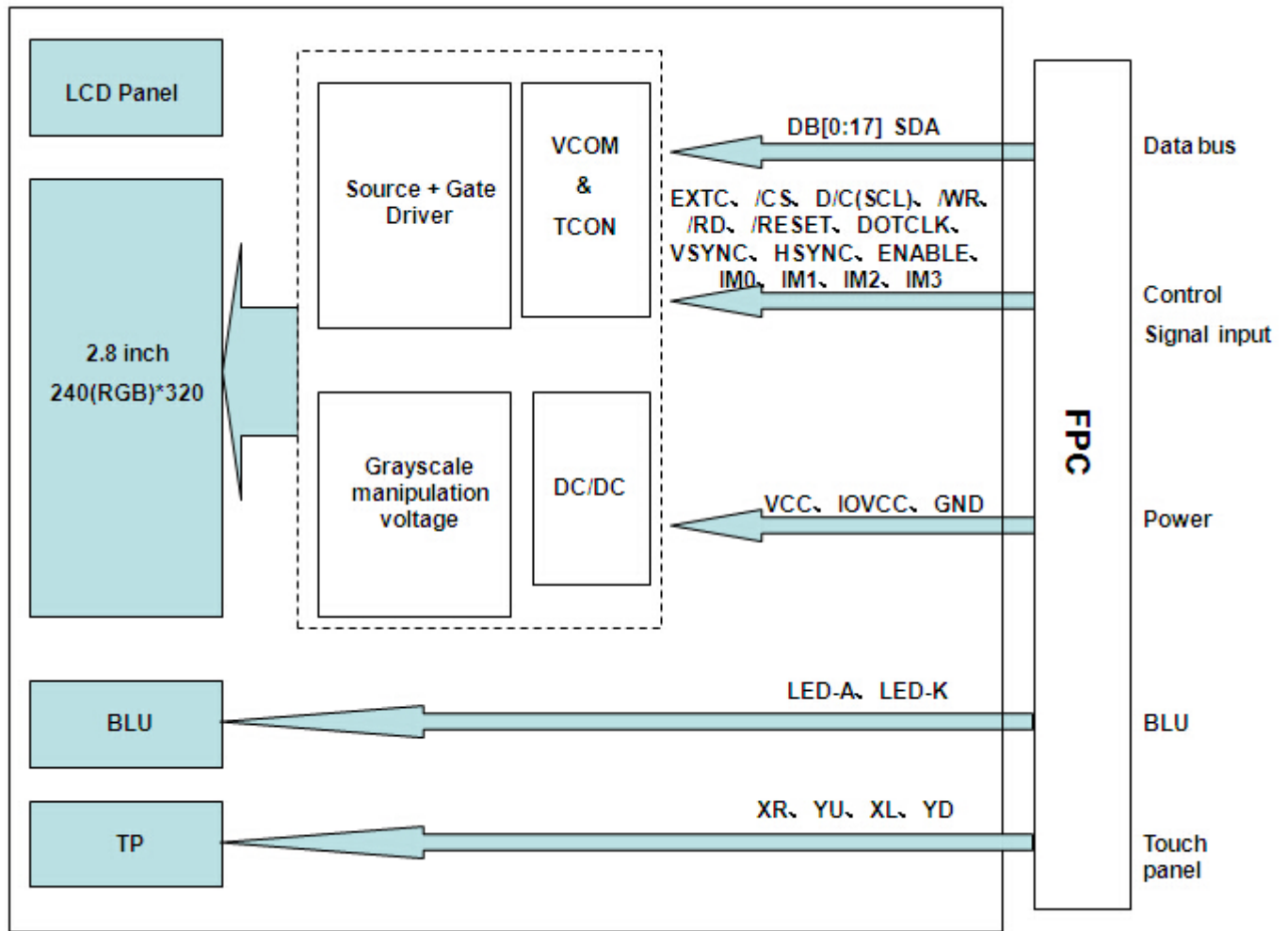
Using the transmissive mode measurement approach, measure the white screen luminance of the display panel and backlight.

- 7.6.1. Surface Luminance: $L_v = \text{average} (L_{P1}:L_{P9})$
- 7.6.2. Uniformity = $\text{Minimal} (L_{P1}:L_{P9}) / \text{Maximal} (L_{P1}:L_{P9}) * 100\%$
- 7.6.3. Transmittance = $L_v \text{ on LCD} / L_v \text{ on Backlight} * 100\%$

Note: Measuring machine: BM-7



8. Block Diagram and Power Supply

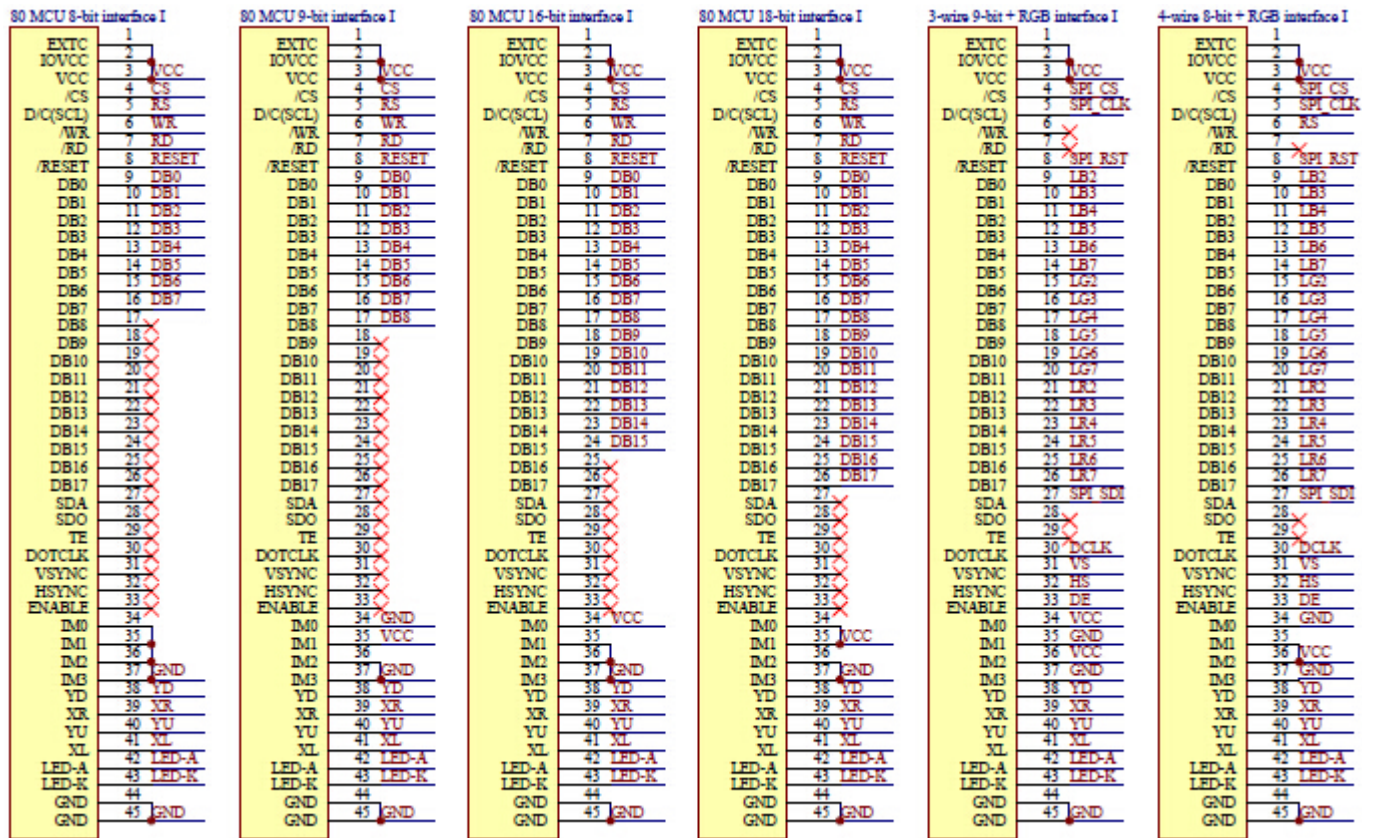


9. Interface Pins Definition

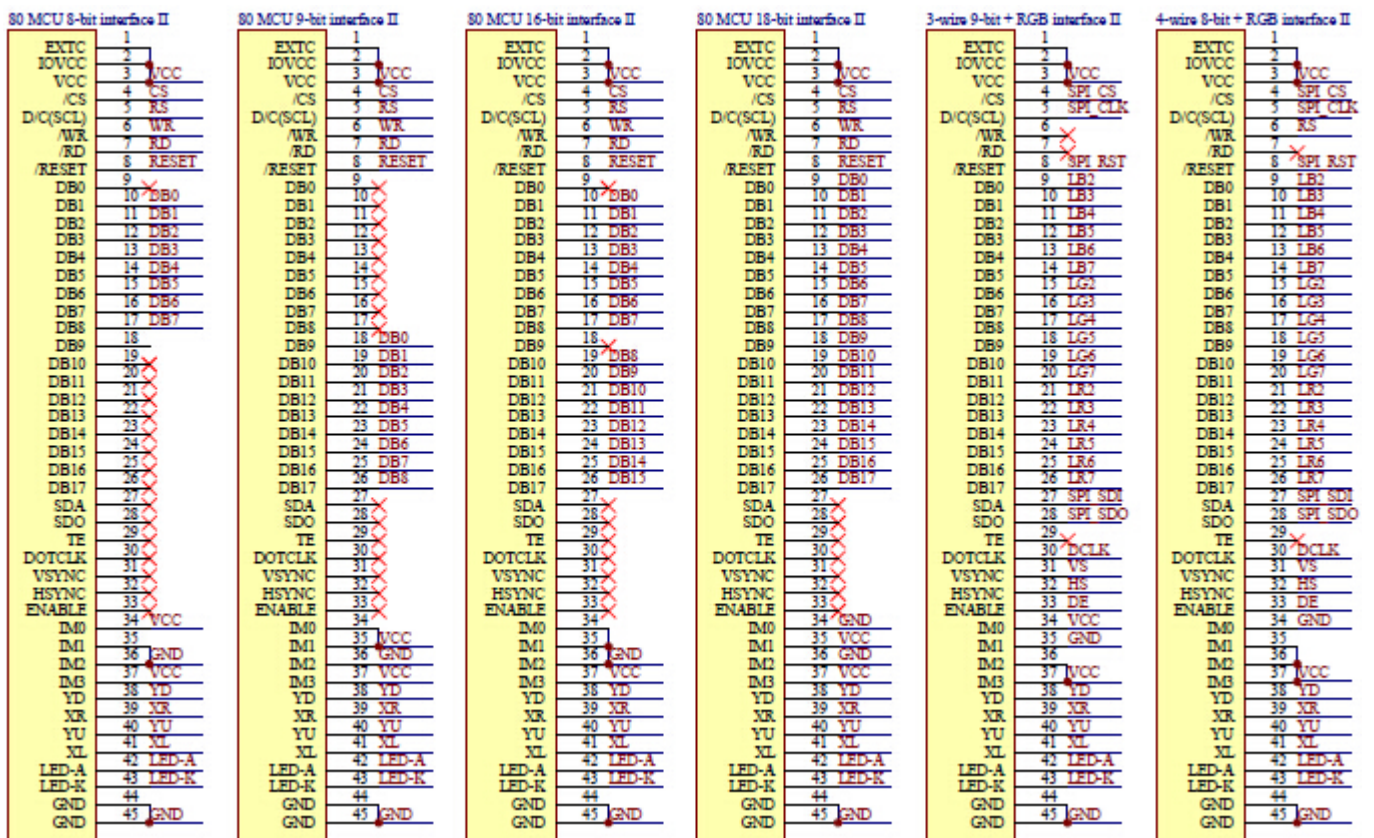
No.	Symbol	Function
1	EXTC	Extended command set enable. High: extended command set is accepted. EXTC must be set "H" to read/write extended registers.
2	IOVCC(1.8/2.8V)	Digital Supply Power.
3	VCC(2.8V)	Analog Supply Power.
4	/CS	Chip Select Signal (Low: active).
5	D/C(SCL)	D/C: Data/Commander Selection. SCL: Serial clock in 3-wire 9-bit/4-wire 8-bit serial data interface.
6	/WR	8080-system: Serves as Write Signal. 4-line system: Serves as the selector of command or parameter.
7	/RD	Read Signal.
8	/RESET	Reset Signal.
9	DB0	Data Bus.
10	DB1	Data Bus.
11	DB2	Data Bus.
12	DB3	Data Bus.
13	DB4	Data Bus.
14	DB5	Data Bus.
15	DB6	Data Bus.
16	DB7	Data Bus.
17	DB8	Data Bus.
18	DB9	Data Bus.
19	DB10	Data Bus.
20	DB11	Data Bus.
21	DB12	Data Bus.
22	DB13	Data Bus.
23	DB14	Data Bus.
24	DB15	Data Bus.
25	DB16	Data Bus.
26	DB17	Data Bus.
27	SDA	SPI interface input pin.
28	SDO	SPI interface output pin.
29	TE	Tearing effect output pin to synchronize MPU to frame writing, active by S/W command.
30	DOTCLK	Pixel clock signal in RGB I/F mode.
31	VSYNC	Vertical sync. Signal in RGB I/F mode.
32	HSYNC	Horizontal sync. Signal in RGB I/F mode.
33	ENABLE	Data enable signal in RGB I/F mode.

34-37	IM0,IM1,IM2,IM3	IM3	IM2	IM1	IM0	MPU interface Mode	DB pin	
							Register	Gram
							0	0
0	0	0	1	80 MCU 16-bit bus interface I	DB[7:0]	DB[15:0]		
0	0	1	0	80 MCU 9-bit bus interface I	DB[7:0]	DB[8:0]		
0	0	1	1	80 MCU 18-bit bus interface I	DB[7:0]	DB[17:0]		
0	1	0	1	3-wire 9-bit data Serial interface I	SDA: in/out			
0	1	1	0	4-wire 8-bit data Serial interface I	SDA: in/out			
1	0	0	0	80 MCU 16-bit bus interface II	DB[8:1]	DB[8:1] DB[17:10]		
1	0	0	1	80 MCU 8-bit bus interface II	DB[17:10]	DB[17:10]		
1	0	1	0	80 MCU 18-bit bus interface II	DB[8:1]	DB[17:0]		
1	0	1	1	80 MCU 9-bit bus interface II	DB[17:10]	DB[17:9]		
1	1	0	1	3-wire 9-bit data Serial interface II	SDI: in SDO: out			
1	1	1	0	4-wire 8-bit data Serial interface II	SDI: in SDO: out			
38	YD	Touch panel terminal.						
39	XR	Touch panel terminal.						
40	YU	Touch panel terminal.						
41	XL	Touch panel terminal.						
42	LED-A	LED Anode.						
43	LED-K	LED Cathode.						
44	GND	Ground.						
45	GND	Ground.						

80 MCU Interface I

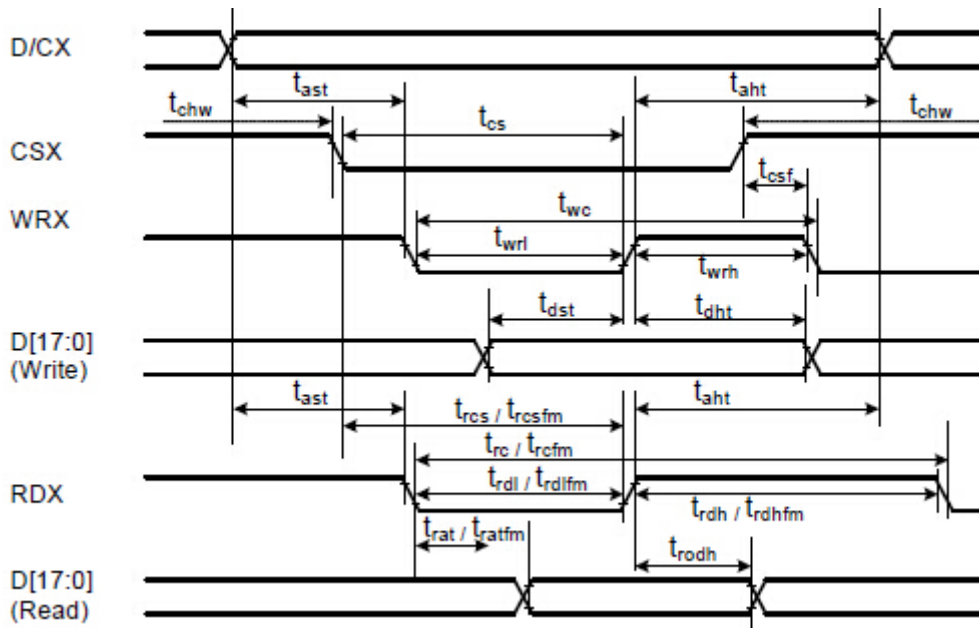


80 MCU Interface II



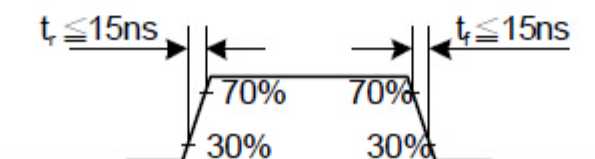
10. AC Characteristics

10.1 Display Parallel 18/16/9/8-bit Interface Timing Characteristics (8080-I system)

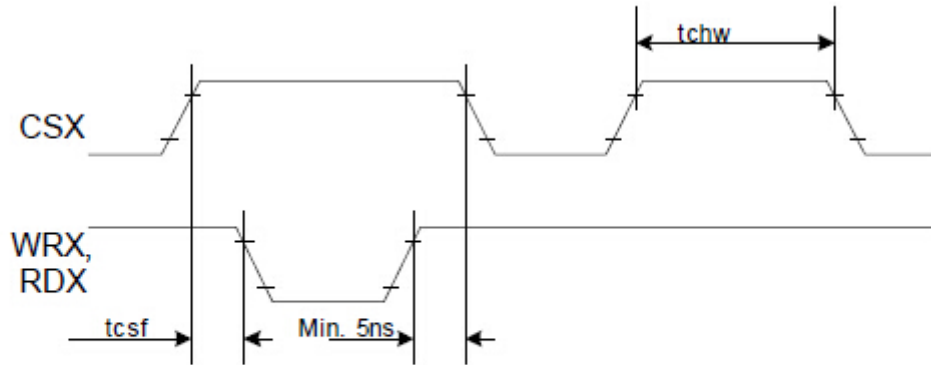


Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	0	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[15:0], D[8:0], D[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Note: $T_a = -30$ to 70 °C, $V_{DDI}=1.65V$ to $3.3V$, $V_{CI}=2.5V$ to $3.3V$, $V_{SS}=0V$

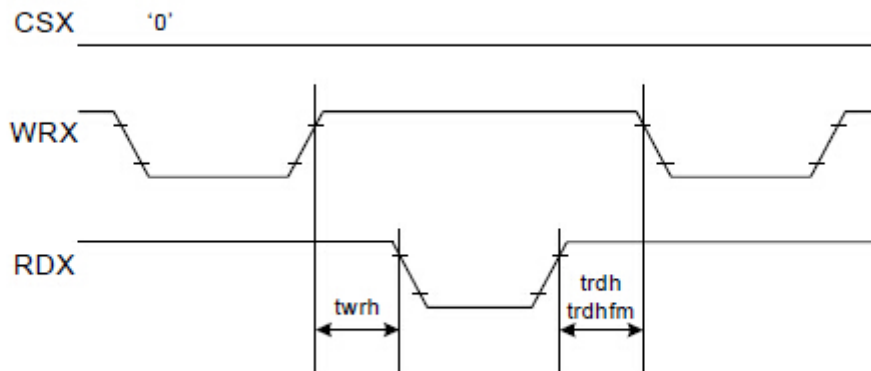


CSX timings :



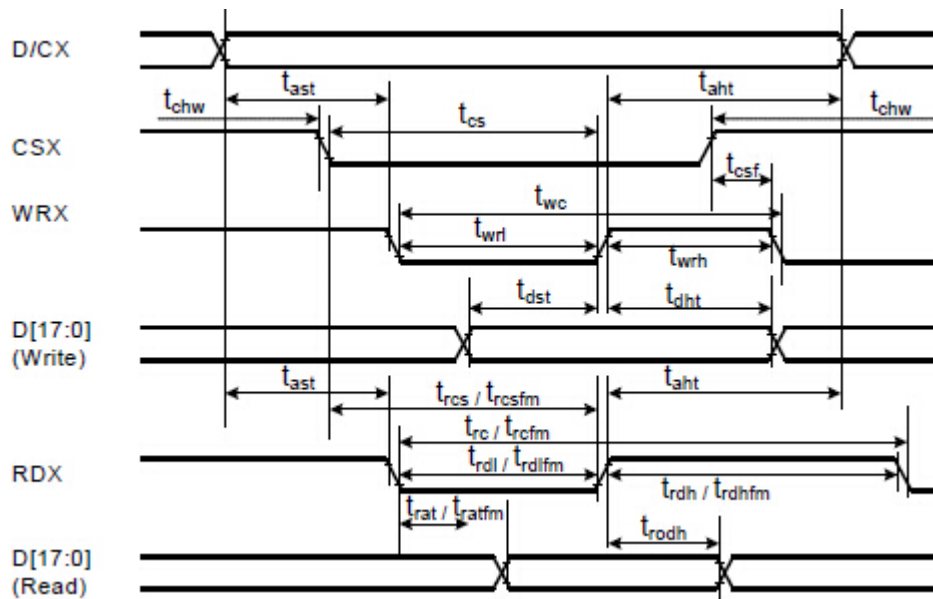
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Write to read or read to write timings:



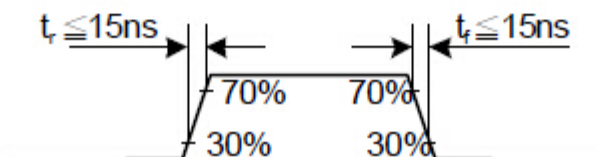
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

10.2 Display Parallel 18/16/9/8-bit Interface Timing Characteristics (8080-II system)

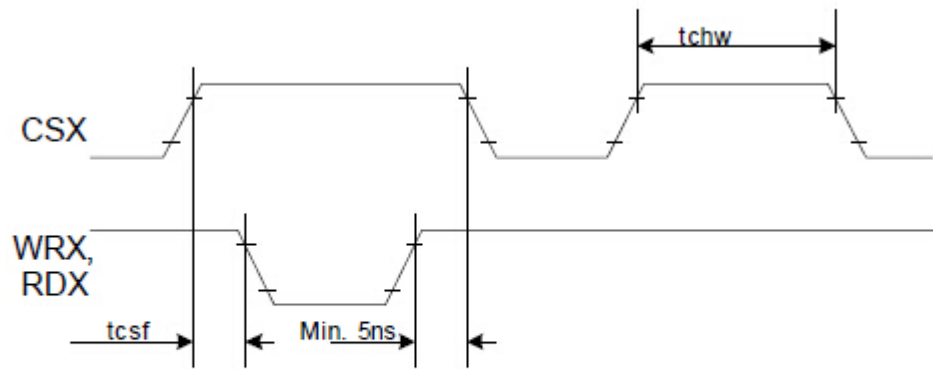


Signal	Symbol	Parameter	min	max	Unit	Description
DCX	t_{ast}	Address setup time	0	-	ns	
	t_{ah}	Address hold time (Write/Read)	0	-	ns	
CSX	t_{chw}	CSX "H" pulse width	0	-	ns	
	t_{cs}	Chip Select setup time (Write)	15	-	ns	
	t_{rcs}	Chip Select setup time (Read ID)	45	-	ns	
	t_{rcsfm}	Chip Select setup time (Read FM)	355	-	ns	
	t_{csf}	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	t_{wc}	Write cycle	66	-	ns	
	t_{wrh}	Write Control pulse H duration	15	-	ns	
	t_{wrl}	Write Control pulse L duration	15	-	ns	
RDX (FM)	t_{rcfm}	Read Cycle (FM)	450	-	ns	
	t_{rdhfm}	Read Control H duration (FM)	90	-	ns	
	t_{rdlfm}	Read Control L duration (FM)	355	-	ns	
RDX (ID)	t_{rc}	Read cycle (ID)	160	-	ns	
	t_{rdh}	Read Control pulse H duration	90	-	ns	
	t_{rdl}	Read Control pulse L duration	45	-	ns	
D[17:0], D[17:10]&D[8:1], D[17:10], D[17:9]	t_{dst}	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	t_{dht}	Write data hold time	10	-	ns	
	t_{rat}	Read access time	-	40	ns	
	t_{ratfm}	Read access time	-	340	ns	
	t_{rodh}	Read output disable time	20	80	ns	

Note: $T_a = -30$ to 70 °C, $V_{DDI}=1.65V$ to $3.3V$, $V_{CI}=2.5V$ to $3.3V$, $V_{SS}=0V$.

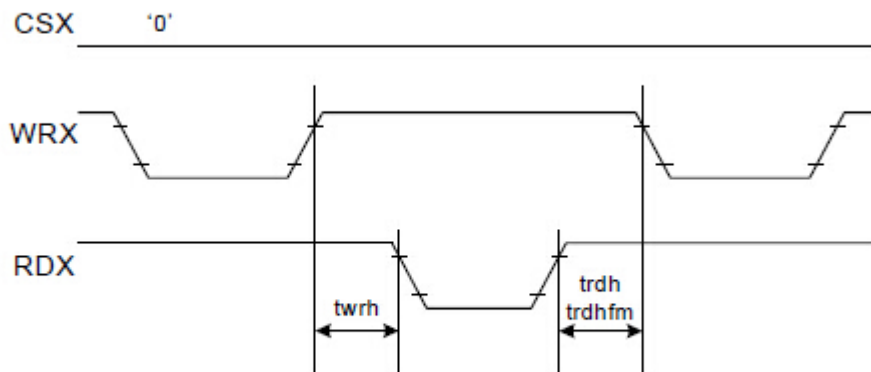


CSX timings :



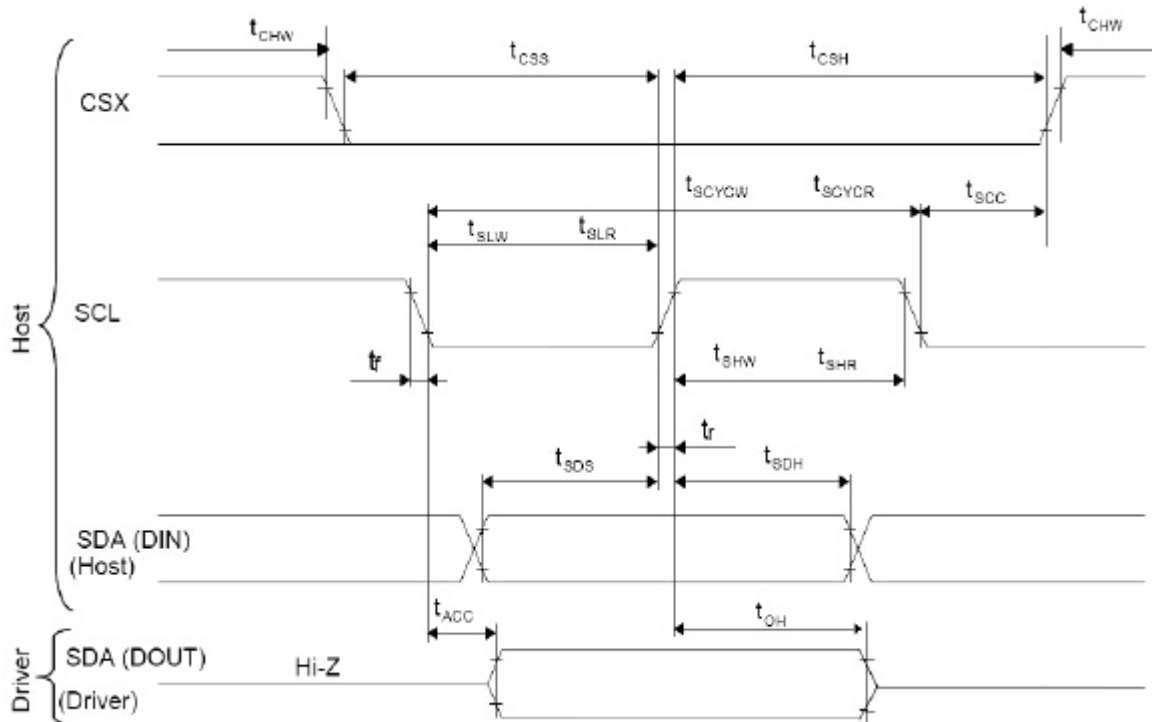
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Write to read or read to write timings:



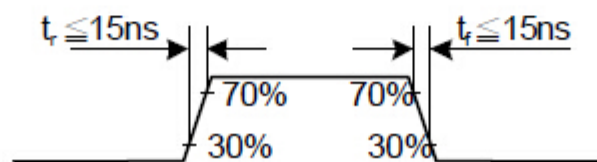
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

10.3 Display Serial Interface Timing Characteristics (3-line SPI system)

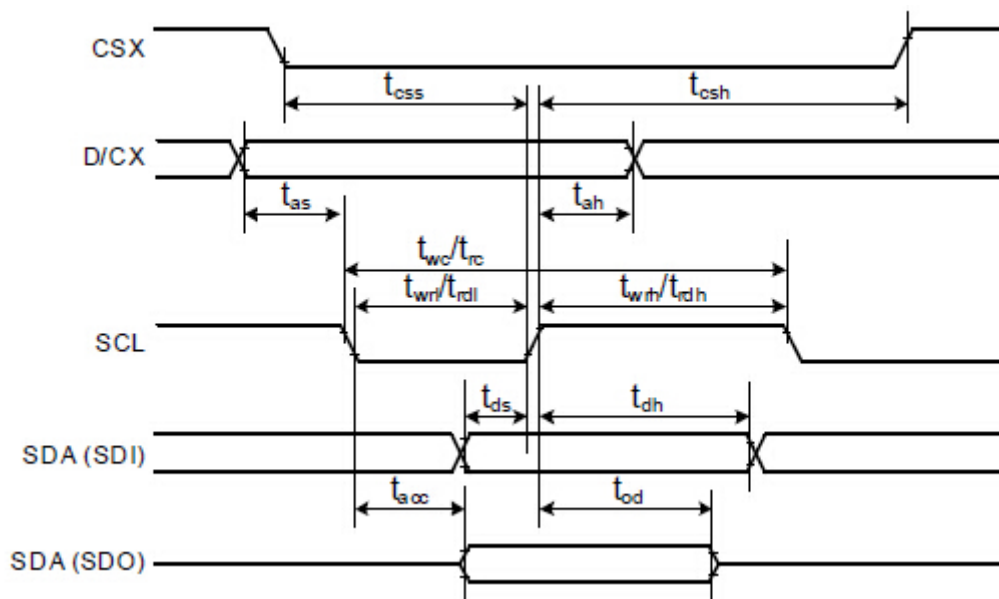


Signal	Symbol	Parameter	min	max	Unit	Description
SCL	tscycw	Serial Clock Cycle (Write)	100	-	ns	
	tshw	SCL "H" Pulse Width (Write)	40	-	ns	
	tslw	SCL "L" Pulse Width (Write)	40	-	ns	
	tscycr	Serial Clock Cycle (Read)	150	-	ns	
	tshr	SCL "H" Pulse Width (Read)	60	-	ns	
	tslr	SCL "L" Pulse Width (Read)	60	-	ns	
SDA / SDI (Input)	tsds	Data setup time (Write)	30	-	ns	
	tsdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	
	toh	Output disable time (Read)	10	50	ns	
CSX	tsc	SCL-CSX	20	-	ns	
	tchw	CSX "H" Pulse Width	40	-	ns	
	tcss	CSX-SCL Time	60	-	ns	
	tchsh		65	-	ns	

Note: $T_a = 25\text{ }^\circ\text{C}$, $V_{DDI}=1.65\text{V to }3.3\text{V}$, $V_{CI}=2.5\text{V to }3.3\text{V}$, $AGND=VSS=0\text{V}$

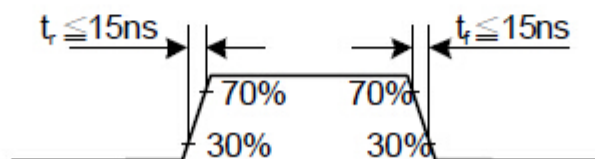


10.4 Display Serial Interface Timing Characteristics (4-line SPI system)

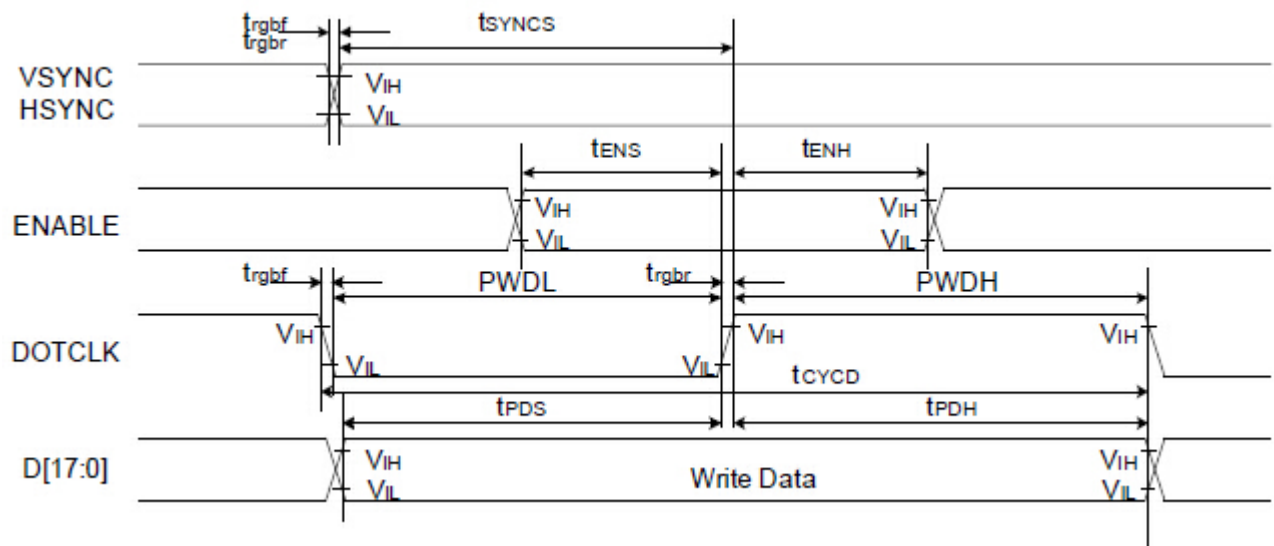


Signal	Symbol	Parameter	min	max	Unit	Description
CSX	t_{css}	Chip select time (Write)	40	-	ns	
	t_{csh}	Chip select hold time (Read)	40	-	ns	
SCL	t_{wc}	Serial clock cycle (Write)	100	-	ns	
	t_{wrh}	SCL "H" pulse width (Write)	40	-	ns	
	t_{wrl}	SCL "L" pulse width (Write)	40	-	ns	
	t_{rc}	Serial clock cycle (Read)	150	-	ns	
	t_{rdh}	SCL "H" pulse width (Read)	60	-	ns	
	t_{rdl}	SCL "L" pulse width (Read)	60	-	ns	
D/CX	t_{as}	D/CX setup time	10	-		
	t_{ah}	D/CX hold time (Write / Read)	10	-		
SDA / SDI (Input)	t_{ds}	Data setup time (Write)	30	-	ns	
	t_{dh}	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	t_{acc}	Access time (Read)	10	-	ns	For maximum CL=30pF
	t_{od}	Output disable time (Read)	10	50	ns	For minimum CL=8pF

Note: $T_a = 25\text{ }^\circ\text{C}$, $V_{DDI}=1.65\text{V to }3.3\text{V}$, $V_{CI}=2.5\text{V to }3.3\text{V}$, $AGND=VSS=0\text{V}$

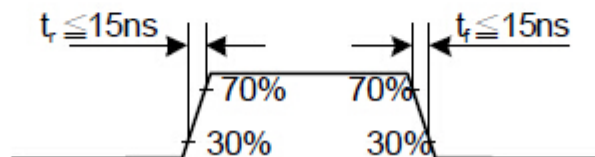


10.5 Parallel 18/16/6-bit RGB Interface Timing Characteristics



Signal	Symbol	Parameter	min	max	Unit	Description	
VSYNC / HSYNC	tSYNCS	VSYNC/HSYNC setup time	15	-	ns	18/16-bit bus RGB interface mode	
	tSYNCH	VSYNC/HSYNC hold time	15	-	ns		
DE	tENS	DE setup time	15	-	ns		
	tENH	DE hold time	15	-	ns		
D[17:0]	tPOS	Data setup time	15	-	ns		
	tPDH	Data hold time	15	-	ns		
DOTCLK	PWDH	DOTCLK high-level period	15	-	ns		
	PWDL	DOTCLK low-level period	15	-	ns		
	tCYCD	DOTCLK cycle time	100	-	ns		
	trgr, trgrf	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns		
VSYNC / HSYNC	tSYNCS	VSYNC/HSYNC setup time	15	-	ns		6-bit bus RGB interface mode
	tSYNCH	VSYNC/HSYNC hold time	15	-	ns		
DE	tENS	DE setup time	15	-	ns		
	tENH	DE hold time	15	-	ns		
D[17:0]	tPOS	Data setup time	15	-	ns		
	tPDH	Data hold time	15	-	ns		
DOTCLK	PWDH	DOTCLK high-level pulse period	15	-	ns		
	PWDL	DOTCLK low-level pulse period	15	-	ns		
	tCYCD	DOTCLK cycle time	50	-	ns		
	trgr, trgrf	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns		

Note: Ta = -30 to 70 °C, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, AGND=VSS=0V



11. Command Table

Regulative Command Set														
Command Function	D/CX	RDX	WRX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex	
No Operation	0	1	↑	XX	0	0	0	0	0	0	0	0	00h	
Software Reset	0	1	↑	XX	0	0	0	0	0	0	0	1	01h	
Read Display Identification Information	0	1	↑	XX	0	0	0	0	0	1	0	0	04h	
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX	
	1	↑	1	XX	ID1 [7:0]							XX		
	1	↑	1	XX	ID2 [7:0]							XX		
	1	↑	1	XX	ID3 [7:0]							XX		
Read Display Status	0	1	↑	XX	0	0	0	0	1	0	0	1	09h	
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX	
	1	↑	1	XX	D [31:25]							0	00	
	1	↑	1	XX	0	D [22:20]			D [19:16]			61		
	1	↑	1	XX	D [15]	0	D [13]	0	0	D [10:8]		00		
Read Display Power Mode	1	↑	1	XX	D [7:5]							D [4:1]	0	00
	0	1	↑	XX	0	0	0	0	1	0	1	0	0Ah	
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX	
Read Display MADCTL	1	↑	1	XX	D [7:2]							0	0	08
	0	1	↑	XX	0	0	0	0	1	0	1	1	0Bh	
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX	
Read Display Pixel Format	1	↑	1	XX	D [7:2]							0	0	00
	0	1	↑	XX	0	0	0	0	1	1	0	0	0Ch	
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX	
Read Display Image Format	1	↑	1	XX	0	DPI [2:0]		0	DBI [2:0]		06			
	0	1	↑	XX	0	0	0	0	1	1	0	1	0Dh	
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX	
Read Display Signal Mode	1	↑	1	XX	0	0	0	0	0	D [2:0]		00		
	0	1	↑	XX	0	0	0	0	1	1	1	0	0Eh	
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX	
Read Display Self-Diagnostic Result	1	↑	1	XX	D [7:2]							0	0	00
	0	1	↑	XX	0	0	0	0	1	1	1	1	0Fh	
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX	
Gamma Set	1	↑	1	XX	D [7:6]							0	0	00
	0	1	↑	XX	0	0	0	1	0	0	0	0	10h	
	0	1	↑	XX	0	0	0	1	0	0	0	1	11h	
	0	1	↑	XX	0	0	0	1	0	0	1	0	12h	
	0	1	↑	XX	0	0	0	1	0	0	1	1	13h	
	0	1	↑	XX	0	0	1	0	0	0	0	0	20h	
	0	1	↑	XX	0	0	1	0	0	0	0	1	21h	
	0	1	↑	XX	0	0	1	0	0	1	1	0	26h	
	1	1	↑	XX	GC [7:0]							01		
	0	1	↑	XX	0	0	1	0	1	0	0	0	28h	
	0	1	↑	XX	0	0	1	0	1	0	0	1	29h	
	Column Address Set	0	1	↑	XX	0	0	1	0	1	0	1	0	2Ah
		1	1	↑	XX	SC [15:8]							XX	
1		1	↑	XX	SC [7:0]							XX		
1		1	↑	XX	EC [15:8]							XX		
Page Address Set	1	1	↑	XX	EC [7:0]							XX		
	0	1	↑	XX	0	0	1	0	1	0	1	1	2Bh	
	1	1	↑	XX	SP [15:8]							XX		
	1	1	↑	XX	SP [7:0]							XX		
Gamma Set	1	1	↑	XX	EP [15:8]							XX		
	1	1	↑	XX	EP [7:0]							XX		

Memory Write	0	1	↑	XX	0	0	1	0	1	1	0	0	2Ch
	1	1	↑		D [17:0]								XX
Color SET	0	1	↑	XX	0	0	1	0	1	1	0	1	2Dh
	1	1	↑	XX	0	0	R00 [5:0]						XX
	1	1	↑	XX	0	0	Rnn [5:0]						XX
	1	1	↑	XX	0	0	R31 [5:0]						XX
	1	1	↑	XX	0	0	G00 [5:0]						XX
	1	1	↑	XX	0	0	Gnn [5:0]						XX
	1	1	↑	XX	0	0	G64 [5:0]						XX
	1	1	↑	XX	0	0	B00 [5:0]						XX
	1	1	↑	XX	0	0	Bnn [5:0]						XX
	1	1	↑	XX	0	0	B31 [5:0]						XX
Memory Read	0	1	↑	XX	0	0	1	0	1	1	1	0	2Eh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1		D [17:0]								XX
Partial Area	0	1	↑	XX	0	0	1	1	0	0	0	0	30h
	1	1	↑	XX	SR [15:8]								00
	1	1	↑	XX	SR [7:0]								00
	1	1	↑	XX	ER [15:8]								01
	1	1	↑	XX	ER [7:0]								3F
Vertical Scrolling Definition	0	1	↑	XX	0	0	1	1	0	0	1	1	33h
	1	1	↑	XX	TFA [15:8]								00
	1	1	↑	XX	TFA [7:0]								00
	1	1	↑	XX	VSA [15:8]								01
	1	1	↑	XX	VSA [7:0]								40
	1	1	↑	XX	BFA [15:8]								00
	1	1	↑	XX	BFA [7:0]								00
Tearing Effect Line OFF	0	1	↑	XX	0	0	1	1	0	1	0	0	34h
Tearing Effect Line ON	0	1	↑	XX	0	0	1	1	0	1	0	1	35h
	1	1	↑	XX	0	0	0	0	0	0	0	M	00
Memory Access Control	0	1	↑	XX	0	0	1	1	0	1	1	0	36h
	1	1	↑	XX	MY	MX	MV	ML	BGR	MH	0	0	00
Vertical Scrolling Start Address	0	1	↑	XX	0	0	1	1	0	1	1	1	37h
	1	1	↑	XX	VSP [15:8]								00
	1	1	↑	XX	VSP [7:0]								00
Idle Mode OFF	0	1	↑	XX	0	0	1	1	1	0	0	0	38h
Idle Mode ON	0	1	↑	XX	0	0	1	1	1	0	0	1	39h
Pixel Format Set	0	1	↑	XX	0	0	1	1	1	0	1	0	3Ah
	1	1	↑	XX	0	DPI [2:0]			0	DBI [2:0]			66
Write Memory Continue	0	1	↑	XX	0	0	1	1	1	1	0	0	3Ch
	1	1	↑		D [17:0]								XX
Read Memory Continue	0	1	↑	XX	0	0	1	1	1	1	1	0	3Eh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1		D [17:0]								XX
Set Tear Scanline	0	1	↑	XX	0	1	0	0	0	1	0	0	44h
	1	1	↑	XX	0	0	0	0	0	0	0	STS [8]	XX
	1	1	↑	XX	STS [7:0]								XX
Get Scanline	0	1	↑	XX	0	1	0	0	0	1	0	1	45h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	0	0	0	0	GTS [9:8]		XX
	1	↑	1	XX	GTS [7:0]								XX
Write Display Brightness	0	1	↑	XX	0	1	0	1	0	0	0	1	51h
	1	1	↑	XX	DBV [7:0]								00

Read Display Brightness	0	1	↑	XX	0	1	0	1	0	0	1	0	52h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	DBV [7:0]								00
Write CTRL Display	0	1	↑	XX	0	1	0	1	0	0	1	1	53h
	1	1	↑	XX	0	0	BCTRL	0	DD	BL	0	0	00
Read CTRL Display	0	1	↑	XX	0	1	0	1	0	1	0	0	54h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	BCTRL	0	DD	BL	0	0	00
Write Content Adaptive Brightness Control	0	1	↑	XX	0	1	0	1	0	1	0	1	55h
	1	1	↑	XX	0	0	0	0	0	0	C [1:0]		00
Read Content Adaptive Brightness Control	0	1	↑	XX	0	1	0	1	0	1	1	0	56h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	0	0	0	0	C [1:0]		00
Write CABC Minimum Brightness	0	1	↑	XX	0	1	0	1	1	1	1	0	5Eh
	1	1	↑	XX	CMB [7:0]								00
Read CABC Minimum Brightness	0	1	↑	XX	0	1	0	1	1	1	1	1	5Fh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	CMB [7:0]								00
Read ID1	0	1	↑	XX	1	1	0	1	1	0	1	0	DAh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	Module's Manufacture [7:0]								XX
Read ID2	0	1	↑	XX	1	1	0	1	1	0	1	1	DBh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	LCD Module / Driver Version [7:0]								XX
Read ID3	0	1	↑	XX	1	1	0	1	1	1	0	0	DCh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	LCD Module / Driver ID [7:0]								XX

Extended Command Set													
Command Function	D/CX	RDX	WRX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex
RGB Interface Signal Control	0	1	↑	XX	1	0	1	1	0	0	0	0	B0h
	1	1	↑	XX	ByPass MODE	RCM [1:0]		0	VSPL	HSPL	DPL	EPL	00
Frame Control (In Normal Mode)	0	1	↑	XX	1	0	1	1	0	0	0	1	B1h
	1	1	↑	XX	0	0	0	0	0	DIVA [1:0]			00
	1	1	↑	XX	0	0	0	RTNA [4:0]				1B	
Frame Control (In Idle Mode)	0	1	↑	XX	1	0	1	1	0	0	1	0	B2h
	1	1	↑	XX	0	0	0	0	0	DIVB [1:0]			00
	1	1	↑	XX	0	0	0	RTNB [4:0]				1B	
Frame Control (In Partial Mode)	0	1	↑	XX	1	0	1	1	0	0	1	1	B3h
	1	1	↑	XX	0	0	0	0	0	DIVC [1:0]			00
	1	1	↑	XX	0	0	0	RTNC [4:0]				1B	
Display Inversion Control	0	1	↑	XX	1	0	1	1	0	1	0	0	B4h
	1	1	↑	XX	0	0	0	0	0	NLA	NLB	NLC	02
Blanking Porch Control	0	1	↑	XX	1	0	1	1	0	1	0	1	B5h
	1	1	↑	XX	0	VFP [6:0]						02	
	1	1	↑	XX	0	VBP [6:0]						02	
	1	1	↑	XX	0	0	0	HFP [4:0]				0A	
	1	1	↑	XX	0	0	0	HBP [4:0]				14	

Display Function Control	0	1	↑	XX	1	0	1	1	0	1	1	0	B6h		
	1	1	↑	XX	0	0	0	0	PTG [1:0]		PT [1:0]		0A		
	1	1	↑	XX	REV	GS	SS	SM	ISC [3:0]				82		
	1	1	↑	XX	0	0	NL [5:0]						27		
	1	1	↑	XX	0	0	PCDIV [5:0]						04		
Entry Mode Set	0	1	↑	XX	1	0	1	1	0	1	1	1	B7h		
	1	1	↑	XX	0	0	0	0	0	GON	DTE	GAS	08		
Backlight Control 1	0	1	↑	XX	1	0	1	1	1	0	0	0	B8h		
	1	1	↑	XX	0	0	0	0	TH_UI [3:0]				0C		
Backlight Control 2	0	1	↑	XX	1	0	1	1	1	0	0	1	B9h		
	1	1	↑	XX	TH_MV [3:0]				TH_ST [3:0]				CC		
Backlight Control 3	0	1	↑	XX	1	0	1	1	1	0	1	0	BAh		
	1	1	↑	XX	0	0	0	0	DTH_UI [3:0]				04		
Backlight Control 4	0	1	↑	XX	1	0	1	1	1	0	1	1	BBh		
	1	1	↑	XX	DTH_MV [3:0]				DTH_ST [3:0]				65		
Backlight Control 5	0	1	↑	XX	1	0	1	1	1	1	0	0	BCh		
	1	1	↑	XX	DIM2 [3:0]				0	DIM1 [2:0]			44		
Backlight Control 7	0	1	↑	XX	1	0	1	1	1	1	1	0	BEh		
	1	1	↑	XX	PWM_DIV [7:0]										0F
Backlight Control 8	0	1	↑	XX	1	0	1	1	1	1	1	1	BFh		
	1	1	↑	XX	0	0	0	0	0	LEDONR	LEDONPOL	LEDPWMOP	00		
Power Control 1	0	1	↑	XX	1	1	0	0	0	0	0	0	C0h		
	1	1	↑	XX	0	0	VRH [5:0]							21	
Power Control 2	0	1	↑	XX	1	1	0	0	0	0	0	1	C1h		
	1	1	↑	XX	0	0	0	1	0	BT [2:0]			10		
VCOM Control 1	0	1	↑	XX	1	1	0	0	0	1	0	1	C5h		
	1	1	↑	XX	0	VMH [6:0]									31
	1	1	↑	XX	0	VML [6:0]									3C
VCOM Control 2	0	1	↑	XX	1	1	0	0	0	1	1	1	C7h		
	1	1	↑	XX	nVM	VMF [6:0]									C0
NV Memory Write	0	1	↑	XX	1	1	0	1	0	0	0	0	D0h		
	1	1	↑	XX	0	0	0	0	0	PGM_ADR [2:0]			00		
	1	1	↑	XX	PGM_DATA [7:0]										XX
NV Memory Protection Key	0	1	↑	XX	1	1	0	1	0	0	0	1	D1h		
	1	1	↑	XX	KEY [23:16]										XX
	1	1	↑	XX	KEY [15:8]										XX
	1	1	↑	XX	KEY [7:0]										XX
NV Memory Status Read	0	1	↑	XX	1	1	0	1	0	0	1	0	D2h		
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX		
	1	↑	1	XX	0	ID2_CNT [2:0]			0	ID1_CNT [2:0]			XX		
	1	↑	1	XX	BUSY	VMF_CNT [2:0]			0	ID3_CNT [2:0]			XX		

Read ID4	0	1	↑	XX	1	1	0	1	0	0	1	1	D3h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	0	0	0	0	0	0	00
	1	↑	1	XX	1	0	0	1	0	0	1	1	93
	1	↑	1	XX	0	1	0	0	0	0	0	1	41
Positive Gamma Correction	0	1	↑	XX	1	1	1	0	0	0	0	0	E0h
	1	1	↑	XX	0	0	0	0	VP0 [3:0]				0F
	1	1	↑	XX	0	0	VP1 [5:0]					16	
	1	1	↑	XX	0	0	VP2 [5:0]					14	
	1	1	↑	XX	0	0	0	0	VP4 [3:0]			0A	
	1	1	↑	XX	0	0	0	VP8 [4:0]				0D	
	1	1	↑	XX	0	0	0	0	VP13 [3:0]			06	
	1	1	↑	XX	0	VP20 [6:0]					43		
	1	1	↑	XX	VP36 [3:0]			VP27 [3:0]				75	
	1	1	↑	XX	0	VP43 [6:0]					33		
	1	1	↑	XX	0	0	0	0	VP50 [3:0]			06	
	1	1	↑	XX	0	0	VP57 [4:0]				0E		
	1	1	↑	XX	0	0	0	0	VP59 [3:0]			00	
	1	1	↑	XX	0	0	VP61 [5:0]					0C	
	1	1	↑	XX	0	0	VP62 [5:0]					09	
	1	1	↑	XX	0	0	0	0	VP63 [3:0]			08	
	Negative Gamma Correction	0	1	↑	XX	1	1	1	0	0	0	0	1
1		1	↑	XX	0	0	0	0	VN0 [3:0]				08
1		1	↑	XX	0	0	VN1 [5:0]					2B	
1		1	↑	XX	0	0	VN2 [5:0]					2D	
1		1	↑	XX	0	0	0	0	VN4 [3:0]			04	
1		1	↑	XX	0	0	VN8 [4:0]				10		
1		1	↑	XX	0	0	0	0	VN13 [3:0]			04	
1		1	↑	XX	0	VN20 [6:0]					3E		
1		1	↑	XX	VN36 [3:0]			VN27 [3:0]				24	
1		1	↑	XX	0	VN43 [6:0]					4E		
1		1	↑	XX	0	0	0	0	VN50 [3:0]			04	
1		1	↑	XX	0	0	VN57 [4:0]				0F		
1		1	↑	XX	0	0	0	0	VN59 [3:0]			0E	
1		1	↑	XX	0	0	VN61 [5:0]					35	
1	1	↑	XX	0	0	VN62 [5:0]					38		
1	1	↑	XX	0	0	0	0	VN63 [3:0]			0F		

Digital Gamma Control 1	0	1	↑	XX	1	1	1	0	0	0	1	0	E2h
1 st Parameter	1	1	↑	XX	RCA0 [3:0]				BCA0 [3:0]				XX
2 nd Parameter	1	1	↑	XX	RCA1 [3:0]				BCA1 [3:0]				XX
3 rd Parameter	1	1	↑	XX	RCA2 [3:0]				BCA2 [3:0]				XX
4 th Parameter	1	1	↑	XX	RCA3 [3:0]				BCA3 [3:0]				XX
5 th Parameter	1	1	↑	XX	RCA4 [3:0]				BCA4 [3:0]				XX
6 th Parameter	1	1	↑	XX	RCA5 [3:0]				BCA5 [3:0]				XX
7 th Parameter	1	1	↑	XX	RCA6 [3:0]				BCA6 [3:0]				XX
8 th Parameter	1	1	↑	XX	RCA7 [3:0]				BCA7 [3:0]				XX
9 th Parameter	1	1	↑	XX	RCA8 [3:0]				BCA8 [3:0]				XX
10 th Parameter	1	1	↑	XX	RCA9 [3:0]				BCA9 [3:0]				XX
11 th Parameter	1	1	↑	XX	RCA10 [3:0]				BCA10 [3:0]				XX
12 th Parameter	1	1	↑	XX	RCA11 [3:0]				BCA11 [3:0]				XX
13 th Parameter	1	1	↑	XX	RCA12 [3:0]				BCA12 [3:0]				XX
14 th Parameter	1	1	↑	XX	RCA13 [3:0]				BCA13 [3:0]				XX
15 th Parameter	1	1	↑	XX	RCA14 [3:0]				BCA14 [3:0]				XX
16 th Parameter	1	1	↑	XX	RCA15 [3:0]				BCA15 [3:0]				XX

Digital Gamma Control 2	0	1	↑	XX	1	1	1	0	0	0	1	1	E3h
1 st Parameter	1	1	↑	XX	RFA0 [3:0]			BFA0 [3:0]			XX		
2 nd Parameter	1	1	↑	XX	RFA1 [3:0]			BFA1 [3:0]			XX		
3 rd Parameter	1	1	↑	XX	RFA2 [3:0]			BFA2 [3:0]			XX		
4 th Parameter	1	1	↑	XX	RFA3 [3:0]			BFA3 [3:0]			XX		
5 th Parameter	1	1	↑	XX	RFA4 [3:0]			BFA4 [3:0]			XX		
6 th Parameter	1	1	↑	XX	RFA5 [3:0]			BFA5 [3:0]			XX		
7 th Parameter	1	1	↑	XX	RFA6 [3:0]			BFA6 [3:0]			XX		
8 th Parameter	1	1	↑	XX	RFA7 [3:0]			BFA7 [3:0]			XX		
9 th Parameter	1	1	↑	XX	RFA8 [3:0]			BFA8 [3:0]			XX		
10 th Parameter	1	1	↑	XX	RFA9 [3:0]			BFA9 [3:0]			XX		
11 th Parameter	1	1	↑	XX	RFA10 [3:0]			BFA10 [3:0]			XX		
12 th Parameter	1	1	↑	XX	RFA11 [3:0]			BFA [3:0]			XX		
13 th Parameter	1	1	↑	XX	RFA12 [3:0]			BFA12 [3:0]			XX		
14 th Parameter	1	1	↑	XX	RFA13 [3:0]			BFA13 [3:0]			XX		
15 th Parameter	1	1	↑	XX	RFA14 [3:0]			BFA14 [3:0]			XX		
16 th Parameter	1	1	↑	XX	RFA15 [3:0]			BFA15 [3:0]			XX		
17 th Parameter	1	1	↑	XX	RFA16 [3:0]			BFA16 [3:0]			XX		
18 th Parameter	1	1	↑	XX	RFA17 [3:0]			BFA17 [3:0]			XX		
19 th Parameter	1	1	↑	XX	RFA18 [3:0]			BFA18 [3:0]			XX		
20 th Parameter	1	1	↑	XX	RFA19 [3:0]			BFA19 [3:0]			XX		
21 st Parameter	1	1	↑	XX	RFA20 [3:0]			BFA20 [3:0]			XX		
22 nd Parameter	1	1	↑	XX	RFA21 [3:0]			BFA21 [3:0]			XX		
23 rd Parameter	1	1	↑	XX	RFA22 [3:0]			BFA22 [3:0]			XX		
24 th Parameter	1	1	↑	XX	RFA23 [3:0]			BFA23 [3:0]			XX		
25 th Parameter	1	1	↑	XX	RFA24 [3:0]			BFA24 [3:0]			XX		
26 th Parameter	1	1	↑	XX	RFA25 [3:0]			BFA25 [3:0]			XX		
27 th Parameter	1	1	↑	XX	RFA26 [3:0]			BFA26 [3:0]			XX		
28 th Parameter	1	1	↑	XX	RFA27 [3:0]			BFA27 [3:0]			XX		
29 th Parameter	1	1	↑	XX	RFA28 [3:0]			BFA28 [3:0]			XX		
30 th Parameter	1	1	↑	XX	RFA29 [3:0]			BFA29 [3:0]			XX		
31 st Parameter	1	1	↑	XX	RFA30 [3:0]			BFA30 [3:0]			XX		
32 nd Parameter	1	1	↑	XX	RFA31 [3:0]			BFA31 [3:0]			XX		
33 rd Parameter	1	1	↑	XX	RFA32 [3:0]			BFA32 [3:0]			XX		
34 th Parameter	1	1	↑	XX	RFA33 [3:0]			BFA33 [3:0]			XX		
35 th Parameter	1	1	↑	XX	RFA34 [3:0]			BFA34 [3:0]			XX		
36 th Parameter	1	1	↑	XX	RFA35 [3:0]			BFA35 [3:0]			XX		
37 th Parameter	1	1	↑	XX	RFA36 [3:0]			BFA36 [3:0]			XX		
38 th Parameter	1	1	↑	XX	RFA37 [3:0]			BFA37 [3:0]			XX		

39 th Parameter	1	1	↑	XX	RFA38 [3:0]	BFA38 [3:0]	XX
40 th Parameter	1	1	↑	XX	RFA39 [3:0]	BFA39 [3:0]	XX
41 st Parameter	1	1	↑	XX	RFA40 [3:0]	BFA40 [3:0]	XX
42 nd Parameter	1	1	↑	XX	RFA41 [3:0]	BFA41 [3:0]	XX
43 rd Parameter	1	1	↑	XX	RFA42 [3:0]	BFA42 [3:0]	XX
44 th Parameter	1	1	↑	XX	RFA43 [3:0]	BFA43 [3:0]	XX
45 th Parameter	1	1	↑	XX	RFA44 [3:0]	BFA44 [3:0]	XX
46 th Parameter	1	1	↑	XX	RFA45 [3:0]	BFA45 [3:0]	XX
47 th Parameter	1	1	↑	XX	RFA46 [3:0]	BFA46 [3:0]	XX
48 th Parameter	1	1	↑	XX	RFA47 [3:0]	BFA47 [3:0]	XX
49 th Parameter	1	1	↑	XX	RFA48 [3:0]	BFA48 [3:0]	XX
50 th Parameter	1	1	↑	XX	RFA49 [3:0]	BFA49 [3:0]	XX
51 st Parameter	1	1	↑	XX	RFA50 [3:0]	BFA50 [3:0]	XX
52 nd Parameter	1	1	↑	XX	RFA51 [3:0]	BFA51 [3:0]	XX
53 rd Parameter	1	1	↑	XX	RFA52 [3:0]	BFA52 [3:0]	XX
54 th Parameter	1	1	↑	XX	RFA53 [3:0]	BFA53 [3:0]	XX
55 th Parameter	1	1	↑	XX	RFA54 [3:0]	BFA54 [3:0]	XX
56 th Parameter	1	1	↑	XX	RFA55 [3:0]	BFA55 [3:0]	XX
57 th Parameter	1	1	↑	XX	RFA56 [3:0]	BFA56 [3:0]	XX
58 th Parameter	1	1	↑	XX	RFA57 [3:0]	BFA57 [3:0]	XX
59 th Parameter	1	1	↑	XX	RFA58 [3:0]	BFA58 [3:0]	XX
60 th Parameter	1	1	↑	XX	RFA59 [3:0]	BFA59 [3:0]	XX
61 st Parameter	1	1	↑	XX	RFA60 [3:0]	BFA60 [3:0]	XX
62 nd Parameter	1	1	↑	XX	RFA61 [3:0]	BFA61 [3:0]	XX
63 rd Parameter	1	1	↑	XX	RFA62 [3:0]	BFA62 [3:0]	XX
64 th Parameter	1	1	↑	XX	RFA63 [3:0]	BFA63 [3:0]	XX

Interface Control	0	1	↑	XX	1	1	1	1	0	1	1	0	F8h
	1	1	↑	XX	MY EOR	MX EOR	MV EOR	0	BGR EOR	0	0	WEMODE	01
	1	1	↑	XX	0	0	EPF [1:0]		0	0	MDT [1:0]		00
	1	1	↑	XX	0	0	ENDIAN	0	DM [1:0]	RM	RIM	00	
Power Control A	0	1	↑	XX	1	1	0	0	1	0	1	1	CBh
	1	1	↑	XX	0	0	1	1	1	0	0	1	39
	1	1	↑	XX	0	0	1	0	1	1	0	0	2C
	1	1	↑	XX	0	0	0	0	0	0	0	0	00
	1	1	↑	XX	0	0	1	1	0	REG_VD[2:0]			30
	1	1	↑	XX	0	0	0	0	0	VBC[2:0]			01
Power Control B	0	1	↑	XX	1	1	0	0	1	1	1	1	CFh
	1	1	↑	XX	0	0	0	0	0	0	0	0	00
	1	1	↑	XX	1	PCEQ	DRV_ena	Power control[1:0]	0	0	1	81	
	1	1	↑	XX	DRV_vm[2:1]		1	DC_ena	DRV_vm[0]	DRV_vmh[2:0]			30
Driver timing control A	0	1	↑	XX	1	1	1	0	1	0	0	0	E8h
	1	1	↑	XX	CR/EQ/PC	SDT[1:0]		0	0	1	0	NOW	84
	1	1	↑	XX	0	0	EQ[2:0]			CR[2:0]			11

	1	1	↑	XX	0	1	1	1	1	PC[1:0]			7A
	0	1	↑	XX	1	1	1	0	1	0	0	1	E9h
Driver timing control B	1	1	↑	XX	CRE/EQE /PCE	SDT[1:0]		0	0	1	0	NOWE	04
	1	1	↑	XX	0	0	EQ[2:0]		CR[2:0]			11	
	1	1	↑	XX	0	1	1	1	1	PC[1:0]			7A
	0	1	↑	XX	1	1	1	0	1	0	1	0	EAh
Driver timing control C	1	1	↑	XX	VG_SW_T4		VG_SW_T3	VG_SW_T2	VG_SW_T1			88	
	0	1	↑	XX	1	1	1	0	1	1	0	1	EDh
Power on sequence control	1	1	↑	XX	0	1	CP1 soft start		0	1	CP23 soft start		55
	1	1	↑	XX	0	0	En_vcl		0	0	En_ddvdh		01
	1	1	↑	XX	0	0	En_vgh		0	0	En_vgl		23
	1	1	↑	XX	DDVDH_ENH		0	0	0	0	0	1	01
	0	1	↑	XX	1	1	1	1	0	0	1	0	F2h
Enable 3G	1	1	↑	XX	0	0	0	0	0	0	1	0	02

Note 1: Undefined commands are treated as NOP (00h) command.

Note 2: B0 to D9 and DE to FF are for factory use of display supplier. USER can decide if these commands are available or they are treated as NOP (00h) commands before shipping to USER. Default value is NOP (00h).

Note 3: Commands 10h, 12h, 13h, 26h, 28h, 29h, 30h, 36h (Bit D4 only), 38h and 39h are updated during V-SYNC when ILI9341V is in Sleep OUT mode to avoid abnormal visual effects. During Sleep IN mode, these commands are updated immediately. Read status (09h), Read display power mode (0Ah), Read display MADCTL (0Bh), Read display pixel format (0Ch), Read display image mode (0Dh), Read display signal mode (0Eh) and Read display self diagnostic result (0Fh) of these commands are updated immediately both in Sleep IN mode and Sleep OUT mode.

12. Quality Assurance

12.1. Purpose

This standard for Quality Assurance assures the quality of LCD module products supplied to customer.

12.2. Standard for Quality Test

12.2.1 Sampling Plan:

ANSI / ASQC Z1.4-1993.

Single sampling, normal inspection.

12.2.2 Sampling Criteria:

Visual inspection: AQL 1.5%

Electrical functional: AQL 0.65%.

12.2.3 Reliability Test:

Detailed requirement refer to Reliability Test Specification.

12.3. Nonconforming Analysis & Disposition

12.3.1 Nonconforming analysis:

12.3.1.1 Customer should provide overall information of non-conforming sample for their complaints.

12.3.1.2 After receipt of detailed information from customer, the analysis of nonconforming parts usually should be finished in one week.

12.3.1.3 If cannot finish the analysis on time, customer will be notified with the progress status.

12.3.2 Disposition of nonconforming:

12.3.2.1 Non-conforming product over PPM level will be replaced.

12.3.2.2 The cause of non-conformance will be analyzed. Corrective action will be discussed and implemented.

12.4. Agreement Items

Shall negotiate with customer if the following situation occurs:

12.4.1 There is any discrepancy in standard of quality assurance.

12.4.2 Additional requirement to be added in product specification.

12.4.3 Any other special problem.

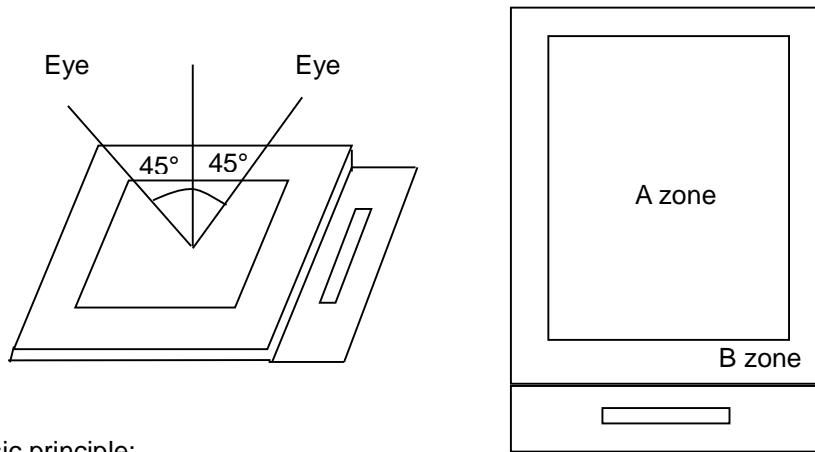
12.5. Standard of the Product Visual Inspection

12.5.1 Appearance inspection:

12.5.1.1 The inspection must be under illumination about 1000 – 1500 lx, and the distance of view must be at 30cm ± 2cm.

12.5.1.2 The viewing angle should be 45° from the vertical line without reflection light or follows customer's viewing angle specifications.

12.5.1.3 Definition of area: A Zone: Active Area, B Zone: Viewing Area,



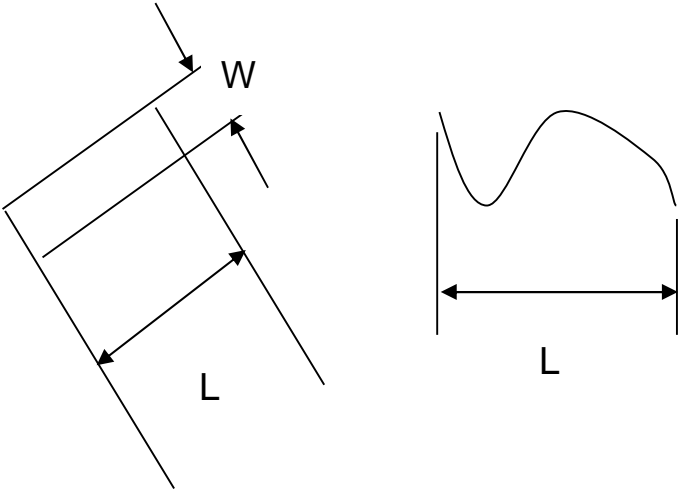
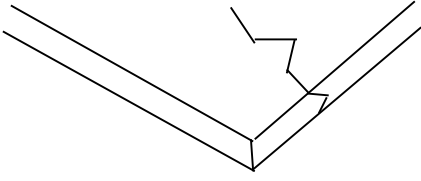
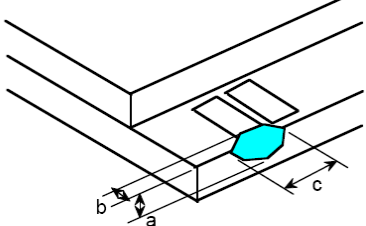
12.5.2 Basic principle:

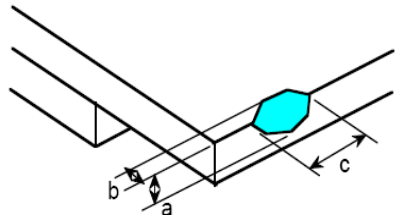
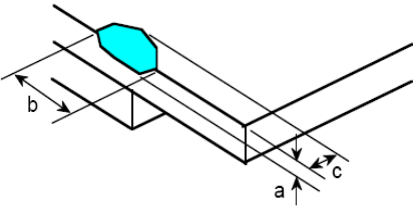
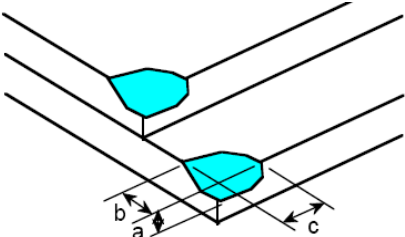
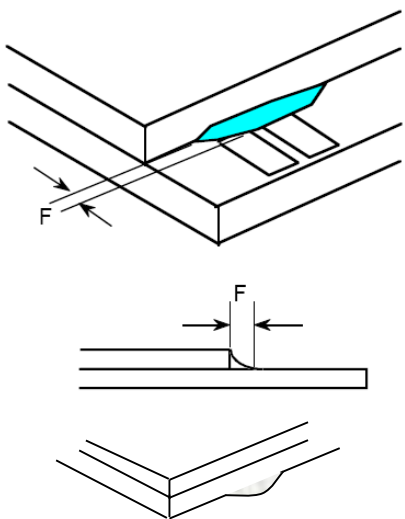
12.5.2.1 A set of sample to indicate the limit of acceptable quality level must be discussed by both us and customer when there is any dispute happened.

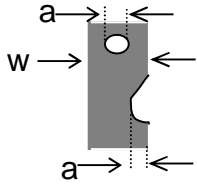
12.5.2.2 New item must be added on time when it is necessary.

12.6. Inspection Specification

No.	Item	Criteria (Unit: mm)																		
01	Black / White Spot Foreign Material (Round Type) Pinholes Stain Particles Inside Cell. (Minor Defect)	<p>$\phi = (a + b) / 2$</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Area</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 0.10$</td> <td></td> <td>Ignore</td> </tr> <tr> <td>$0.10 < \phi \leq 0.15$</td> <td></td> <td>2</td> </tr> <tr> <td>$0.15 < \phi \leq 0.25$</td> <td></td> <td>1</td> </tr> <tr> <td>$0.25 < \phi$</td> <td></td> <td>0</td> </tr> <tr> <td>Total</td> <td></td> <td>2 no include $\phi \leq 0.10$</td> </tr> </tbody> </table> <p>Distance between 2 defects should more than 3mm apart.</p>	Size	Area	Acc. Qty	$\phi \leq 0.10$		Ignore	$0.10 < \phi \leq 0.15$		2	$0.15 < \phi \leq 0.25$		1	$0.25 < \phi$		0	Total		2 no include $\phi \leq 0.10$
Size	Area	Acc. Qty																		
$\phi \leq 0.10$		Ignore																		
$0.10 < \phi \leq 0.15$		2																		
$0.15 < \phi \leq 0.25$		1																		
$0.25 < \phi$		0																		
Total		2 no include $\phi \leq 0.10$																		
02	Electrical Defect (Minor Defect)	<table border="1"> <thead> <tr> <th></th> <th>Display Area</th> <th>Total</th> <th></th> </tr> </thead> <tbody> <tr> <td>Bright dot</td> <td>0</td> <td>0</td> <td rowspan="3">Note1</td> </tr> <tr> <td>Dark dot</td> <td>$N \leq 2$</td> <td>$N \leq 2$</td> </tr> <tr> <td>Total dot</td> <td>$N \leq 2$</td> <td>$N \leq 2$</td> </tr> <tr> <td>Mura</td> <td colspan="2">Not visible through 5% ND filters.</td> <td>Note 2</td> </tr> </tbody> </table> <p>Remark: 1. Bright dot caused by scratch and foreign object accords to item 1.</p>		Display Area	Total		Bright dot	0	0	Note1	Dark dot	$N \leq 2$	$N \leq 2$	Total dot	$N \leq 2$	$N \leq 2$	Mura	Not visible through 5% ND filters.		Note 2
	Display Area	Total																		
Bright dot	0	0	Note1																	
Dark dot	$N \leq 2$	$N \leq 2$																		
Total dot	$N \leq 2$	$N \leq 2$																		
Mura	Not visible through 5% ND filters.		Note 2																	

<p>03</p>	<p>Black and White Line Scratch Foreign Material (Line Type) (Minor Defect)</p>	 <table border="1" data-bbox="614 728 1236 1030"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>/</td> <td>$W \leq 0.03$</td> <td>Ignore</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.03 < W \leq 0.05$</td> <td>3</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.05 < W \leq 0.10$</td> <td>2</td> </tr> <tr> <td>/</td> <td>$0.1 < W$</td> <td>0</td> </tr> <tr> <td colspan="2">Total</td> <td>3</td> </tr> </tbody> </table> <p>Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.</p>	Length	Width	Acc. Qty	/	$W \leq 0.03$	Ignore	$L \leq 2.5$	$0.03 < W \leq 0.05$	3	$L \leq 2.5$	$0.05 < W \leq 0.10$	2	/	$0.1 < W$	0	Total		3
Length	Width	Acc. Qty																		
/	$W \leq 0.03$	Ignore																		
$L \leq 2.5$	$0.03 < W \leq 0.05$	3																		
$L \leq 2.5$	$0.05 < W \leq 0.10$	2																		
/	$0.1 < W$	0																		
Total		3																		
<p>04</p>	<p>Glass Crack (Minor Defect)</p>	 <p>Crack is potential to enlarge, any type is not allowed.</p>																		
<p>05</p>	<p>Glass Chipping Pad Area: (Minor Defect)</p> 	<table border="1" data-bbox="869 1612 1340 1780"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>3</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c > 3.0, b < 1.0$	1	$c < 3.0, b < 1.0$	3	$a < \text{Glass Thickness}$											
Length and Width	Acc. Qty																			
$c > 3.0, b < 1.0$	1																			
$c < 3.0, b < 1.0$	3																			
$a < \text{Glass Thickness}$																				

<p>06</p>	<p>Glass Chipping Rear of Pad Area: (Minor Defect)</p> 	<table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>2</td> </tr> <tr> <td>$c < 3.0, b < 0.5$</td> <td>4</td> </tr> <tr> <td colspan="2">a < Glass Thickness</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c > 3.0, b < 1.0$	1	$c < 3.0, b < 1.0$	2	$c < 3.0, b < 0.5$	4	a < Glass Thickness	
Length and Width	Acc. Qty											
$c > 3.0, b < 1.0$	1											
$c < 3.0, b < 1.0$	2											
$c < 3.0, b < 0.5$	4											
a < Glass Thickness												
<p>07</p>	<p>Glass Chipping Except Pad Area: (Minor Defect)</p> 	<table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>2</td> </tr> <tr> <td>$c < 3.0, b < 0.5$</td> <td>4</td> </tr> <tr> <td colspan="2">a < Glass Thickness</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c > 3.0, b < 1.0$	1	$c < 3.0, b < 1.0$	2	$c < 3.0, b < 0.5$	4	a < Glass Thickness	
Length and Width	Acc. Qty											
$c > 3.0, b < 1.0$	1											
$c < 3.0, b < 1.0$	2											
$c < 3.0, b < 0.5$	4											
a < Glass Thickness												
<p>08</p>	<p>Glass Corner Chipping: (Minor Defect)</p> 	<table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c < 3.0, b < 3.0$</td> <td>Ignore</td> </tr> <tr> <td colspan="2">a < Glass Thickness</td> </tr> </tbody> </table>	Length and Width	Acc. Qty	$c < 3.0, b < 3.0$	Ignore	a < Glass Thickness					
Length and Width	Acc. Qty											
$c < 3.0, b < 3.0$	Ignore											
a < Glass Thickness												
<p>09</p>	<p>Glass Burr: (Minor Defect)</p> 	<table border="1"> <thead> <tr> <th>Length</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$F < 1.0$</td> <td>Ignore</td> </tr> </tbody> </table> <p>Glass burr don't affect assemble and module dimension.</p>	Length	Acc. Qty	$F < 1.0$	Ignore						
Length	Acc. Qty											
$F < 1.0$	Ignore											

10	<p>FPC Defect: (Minor Defect)</p> 	<p>10.1 Dent, pinhole width $a < w/3$. (w: circuitry width.) 10.2 Open circuit is unacceptable. 10.3 No oxidation, contamination and distortion.</p>										
11	<p>Bubble on Polarizer (Minor Defect)</p>	<table border="1"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\varphi \leq 0.20$</td> <td>Ignore</td> </tr> <tr> <td>$0.20 < \varphi \leq 0.30$</td> <td>4</td> </tr> <tr> <td>$0.30 < \varphi \leq 0.50$</td> <td>1</td> </tr> <tr> <td>$0.50 < \varphi$</td> <td>None</td> </tr> </tbody> </table>	Diameter	Acc. Qty	$\varphi \leq 0.20$	Ignore	$0.20 < \varphi \leq 0.30$	4	$0.30 < \varphi \leq 0.50$	1	$0.50 < \varphi$	None
Diameter	Acc. Qty											
$\varphi \leq 0.20$	Ignore											
$0.20 < \varphi \leq 0.30$	4											
$0.30 < \varphi \leq 0.50$	1											
$0.50 < \varphi$	None											
12	<p>Dent on Polarizer (Minor Defect)</p>	<table border="1"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\varphi \leq 0.20$</td> <td>Ignore</td> </tr> <tr> <td>$0.20 < \varphi \leq 0.30$</td> <td>4</td> </tr> <tr> <td>$0.30 < \varphi \leq 0.50$</td> <td>1</td> </tr> <tr> <td>$0.50 < \varphi$</td> <td>None</td> </tr> </tbody> </table>	Diameter	Acc. Qty	$\varphi \leq 0.20$	Ignore	$0.20 < \varphi \leq 0.30$	4	$0.30 < \varphi \leq 0.50$	1	$0.50 < \varphi$	None
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$0.30 < \varphi \leq 0.50$	1											
$0.50 < \varphi$	None											
13	<p>Bezel</p>	<p>13.1 No rust, distortion on the Bezel. 13.2 No visible fingerprints, stains or other contamination.</p>										
14	<p>Touch Panel</p>	<p>D: Diameter W: width L: length 14.1 Spot: $D < 0.25$ is acceptable $0.25 \leq D \leq 0.4$ 2dots are acceptable and the distance between defects should more than 10 mm. $D > 0.4$ is unacceptable 14.2 Dent: $D > 0.40$ is unacceptable 14.3 Scratch: $W \leq 0.03$, $L \leq 10$ is acceptable, $0.03 < W \leq 0.10$, $L \leq 10$ is acceptable Distance between 2 defects should more than 10 mm. $W > 0.10$ is unacceptable.</p>										
15	<p>LCD Ripple</p>	<p>Touch the touch panel, cannot see the LCD ripple. Pen: R 0.8mm silicon rubber. Operation Force:120g</p>										

16	PCB	16.1 No distortion or contamination on PCB terminals. 16.2 All components on PCB must same as documented on the BOM/component layout. 16.3 Follow IPC-A-600F.
17	Soldering	Follow IPC-A-610C standard
18	Electrical Defect (Major Defect)	The below defects must be rejected. 18.1 Missing vertical / horizontal segment, 18.2 Abnormal Display. 18.3 No function or no display. 18.4 Current exceeds product specifications. 18.5 LCD viewing angle defect. 18.6 No Backlight. 18.7 Dark Backlight. 18.8 Touch Panel no function.

Remark: LCD Panel Broken shall be rejected. Defect out of LCD viewing area is acceptable.

12.7. Classification of Defects

12.7.1 Visual defects (Except no / wrong label) are treated as minor defect and electrical defect is major.

12.7.2 Two minor defects are equal to one major in lot sampling inspection.

12.8. Identification/marketing criteria

Any unit with illegible / wrong /double or no marking/ label shall be rejected.

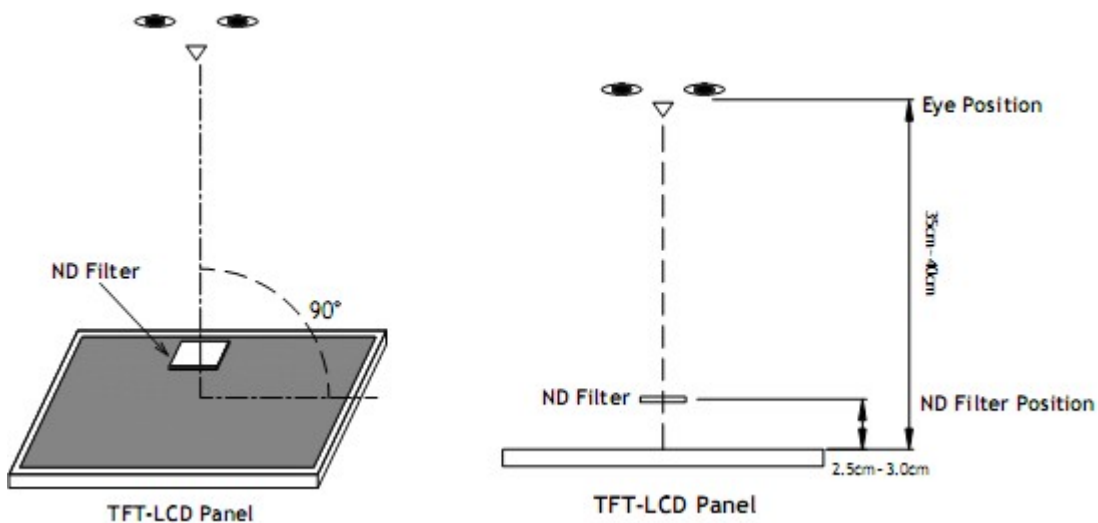
12.9. Packaging

12.9.1 There should be no damage of the outside carton box, each packaging box should have one identical label.

12.9.2 Modules inside package box should have compliant mark.

12.9.3 All direct package materials shall offer ESD protection

Note1: Bright dot is defined as the defective area of the dot is larger than 50% of one sub-pixel area.



Bright dot: The bright dot size defect at black display pattern. It can be recognized by 2% transparency of

filter when the distance between eyes and panel is 350mm± 50mm.

Dark dot: Cyan, Magenta or Yellow dot size defect at white display pattern. It can be recognized by 5% transparency of filter when the distance between eyes and panel is 350mm± 50mm.

Note2: Mura on display which appears darker / brighter against background brightness on parts of display area.

13. Reliability Specification

No	Item	Condition	Quantity	Criteria
1	High Temperature Operating	70°C, 96Hrs	2	GB/T2423.2-2008
2	Low Temperature Operating	-20°C, 96Hrs	2	GB/T2423.1-2008
3	High Humidity	50°C, 90%RH, 96Hrs	2	GB/T2423.3-2016
4	High Temperature Storage	80°C, 96Hrs	2	GB/T2423.2-2008
5	Low Temperature Storage	-30°C, 96Hrs	2	GB/T2423.1-2008
6	Thermal Cycling Test	-20°C, 60min~70°C, 60min, 20 cycles.	2	GB/T2423.22-2012
7	Packing Vibration	Frequency range:10Hz~50Hz Acceleration of gravity:5G X, Y, Z 30 min for each direction.	2	GB/T5170.14-2009
8	Electrical Static Discharge	Air: ± 8kV 150pF/330 Ω 5 times	2	GB/T17626.2-2018
		Contact: ± 4kV 150pF/330 Ω 5 times		
9	Drop Test (Packaged)	Height:80 cm,1 corner, 3 edges, 6 surfaces.	2	GB/T2423.8-1995

Note1. No deflection cosmetic and operational function allowable.

Note2. Total current Consumption should be below double of initial value.

14. Precautions and Warranty

14.1 Safety

- 14.1.1. The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.
- 14.1.2. Since the liquid crystal cells are made of glass, do not apply strong impact on them. Handle with care.

14.2. Handling

- 14.2.1. Reverse and use within ratings in order to keep performance and prevent damage.
- 14.2.2. Do not wipe the polarizer with dry cloth, as it might cause scratch. If the surface of the LCD needs to be cleaned, wipe it swiftly with cotton or other soft cloth soaked with petroleum IPA, do not use other chemicals.

14.3. Storage

- 14.3.1 Do not store the LCD module beyond the specified temperature ranges.

14.4. Metal Pin (Apply to Products with Metal Pins)

14.4.1. Pins of LCD and Backlight

- 14.4.1.1. Solder tip can touch and press on the tip of Pin LEAD during the soldering

14.4.1.2. Recommended Soldering Conditions

Solder Type: Sn96.3~94-Ag3.3~4.3-Cu0.4~1.1

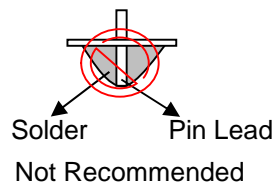
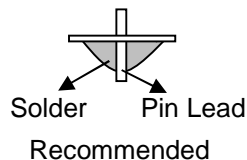
Maximum Solder Temperature: 370°C

Maximum Solder Time: 3s at the maximum temperature

Recommended Soldering Temp: 350±20°C

Typical Soldering Time: ≤3s

14.4.1.3. Solder Wetting



14.4.2. Pins of EL

- 14.4.2.1. Solder tip can touch and press on the tip of EL leads during soldering.

- 14.4.2.2. No Solder Paste on the soldering pad on the motherboard is recommended.

14.4.2.3. Recommended Soldering Conditions

Solder type: Nippon Alimit Leadfree SR-34, size 0.5mm

Recommended Solder Temperature: 270~290°C

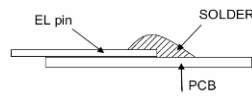
Typical Soldering Time: ≤2s

Minimum solder distance from EL lamp (body):2.0mm

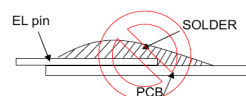
14.4.2.4. No horizontal press on the EL leads during soldering.

14.4.2.5. 180° bend EL leads three times is not allowed.

14.4.2.6. Solder Wetting

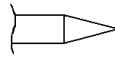


Recommended

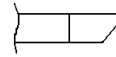


Not Recommended

14.4.2.7. The type of the solder iron:

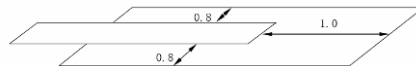


Recommended



Not Recommended

14.4.2.8. Solder Pad



14.5.Operation

- 14.5.1. Do not drive LCD with DC voltage
- 14.5.2. Response time will increase below lower temperature
- 14.5.3. Display may change color with different temperature
- 14.5.4. Mechanical disturbance during operation, such as pressing on the display area, may cause the segments to appear “fractured”.

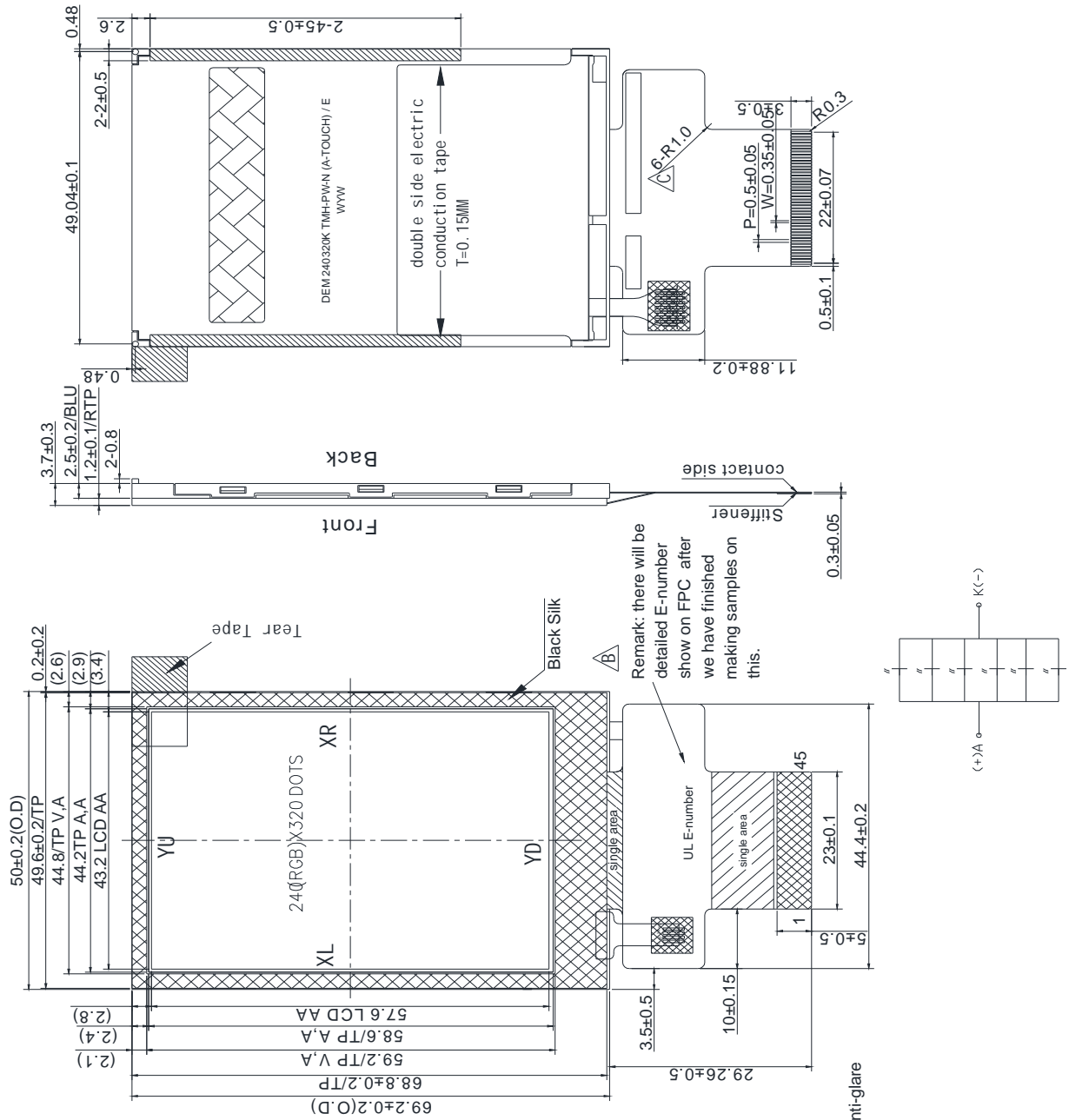
14.6.Static Electricity

- 14.6.1. CMOS LSIs are equipped in this unit, so care must be taken to avoid the electro-static charge, by ground human body, etc.
- 14.6.2. The normal static prevention measures should be observed for work clothes and benches.
- 14.6.3. The module should be kept into anti-static bags or other containers resistant to static for storage.

14.7.Limited Warranty

- 14.7.1. Our warranty liability is limited to repair and/or replacement. We will not be responsible for any consequential loss.
- 14.7.2. If possible, we suggest customer to use up all modules in six months. If the module storage time over twelve months, we suggest that recheck it before the module be used.
- 14.7.3. After the product shipped, any product quality issues must be feedback within three months, otherwise, we will not be responsible for the subsequent or consequential events.

15. Outline Drawing



PIN ASSIGNMENT	PIN ASSIGNMENT	PIN ASSIGNMENT
1 EXT_C	24 DB15	
2 I0VCC(1.8/2.8V)	25 DB16	
3 VCC(2.8V)	26 DB17	
4 /CS	27 SDA	
5 D/C(SCL)	28 SDO	
6 /WR	29 TE	
7 /RD	30 DOTCLK	
8 /RESET	31 VSYNC	
9 DB0	32 HSYNC	
10 DB1	33 ENABLE	
11 DB2	34 IM0	
12 DB3	35 IM1	
13 DB4	36 IM2	
14 DB5	37 IM3	
15 DB6	38 YD	
16 DB7	39 XR	
17 DB8	40 YU	
18 DB9	41 XL	
19 DB10	42 LED_A	
20 DB11	43 LED_K	
21 DB12	44 GND	
22 DB13	45 GND	
23 DB14		

- NOTES:
1. Display size: 2.8" TFT
 2. Viewing direction: 6 O'CLOCK
 3. Gary Scale inversion direction: 12 O'CLOCK
 4. Display mode: Transmissive/Normal white/Anti-glare
 5. Operation temperature: -20°C--+70°C
 6. Storage temperature: -30°C--+80°C
 7. Driver IC: ILI9341V Δ
 8. Power supply voltage: 2.8V
 9. Backlight : White (6 LED)/3.2(TYP)/120mA
 10. Luminance: 560cd/m2(tp) Δ
 11. Life time: 2W(min)hrs~3W(tp)hrs
 12. ROHS must be complied
- * Unspecification tolerance are ± 0.2 mm
 * The dimension with mark brackets "()" just for reference